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COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

REVIEW
OF
APPLIED ENTOMOLOGY.

SERIES A.

Vol. 48. 1960.

EDITORIAL

THE NOMENCLATURE OF CHEMICALS USED IN PEST CONTROL

Since the earlier list of names for chemicals used in pest control was published in this *Review* [*cf. R.A.E.*, A **41** 1–3], the number of common names made available for such materials has increased considerably. Notable contributions have been made in Britain in British Standard 1831: 1957 and in its supplements No. 1 (1959) and No. 2 (*in press*) and in the United States in the list of insecticides compiled by the Committee on Insecticide Terminology of the Entomological Society of America and published in the *Journal of Economic Entomology* **50** (1957) pp. 226–228, with additions in **51** (1958) p. 373, and in the list of fungicides published in *Phytopathology* **45** (1955) pp. 295–302.

To enable full advantage of these developments to be taken in the *Review*, a revised and expanded list is presented of the names for chemicals that will be used in abstracts without further chemical definition unless special considerations render this undesirable. When the name used in the *Review* differs substantially from a common or proprietary name used by the author of the paper abstracted, the latter will also be indicated. In addition to insecticides and acaricides, a few fungicides and other materials are now included. The arrangement follows the earlier model, and names marked by " a " are approved by the Committee of the Entomological Society of America, names marked by " b " are adopted in the British Standard (with its supplements), those marked by " c " have been adopted by the U.S. Interdepartmental Committee on Pest Control, and those marked " d " are cited in the list in *Phytopathology*.

When additions to the list or changes in it become desirable, they will be announced in the *Review*.

Common name used	Chemical names or definitions	Other names
aldrin [a,b,c]	not less than 95 per cent. HHDN [*q.v.*]	
allethrin [a,b,c] ..	*dl*-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one esterified with a mixture of *cis* and *trans* *dl*-chrysanthemic acids	allyl homologue of cinerin I, synthetic pyrethrins
amiton [b]	O,O-diethyl S-2-(diethylamino)ethyl phosphorothioate	
amiton oxalate ..	hydrogen-oxalate salt of amiton [*q.v.*]	Chipman R-6199 [a]
BHC [a,b]	1,2,3,4,5,6-hexachlorocyclohexane benzene hexachloride (BHC is used for a mixture of isomers; the British Standard requires that the percentage of γ BHC be stated.)	HCH, 666
α BHC, β BHC, γ BHC, etc.	individual isomers of the above	
bromo-DDT ..	a complex chemical mixture in which p,p'bromo-DDT [*q.v.*] predominates	
p,p'bromo-DDT	1,1-di(p-bromophenyl)-2,2,2-trichloroethane	
Bulan [a]	1,1-di(p-chlorophenyl)-2-nitrobutane	
butonate	O,O-dimethyl 2,2,2-trichloro-1-n-butyryloxyethylphosphonate	
captan [b,d] ..	N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide	
chlorbenside [b] ..	p-chlorobenzyl p-chlorophenyl sulphide	Chlorbenside [a], Chlorparacide
chlordane [a,b,c] ..	1,2,4,5,6,7,10,10-octachloro-4,7,8,9-tetrahydro-4,7-*endo*methyleneindane 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene	
chlorfenson [b] ..	p-chlorophenyl p-chlorobenzenesulphonate	ovex [a], Ovotran, CPCBS
chlorobenzilate [b] ..	ethyl p,p'-dichlorobenzilate	Chlorobenzilate [a]
Chlorthion [a] ..	O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate	
chrysanthemic acid	chrysanthemum monocarboxylic acid	chrysanthemumic acid
cyclethrin [a] ..	*dl*-2-(2-cyclopentenyl)-4-hydroxy-3-methyl-2-cyclopenten-1-one esterified with a mixture of *cis* and *trans* *dl*-chrysanthemic acids	
DDA	di(p-chlorophenyl)acetic acid	
DDD	a complex chemical mixture in which p,p'DDD [*q.v.*] predominates	TDE [a]
p,p'DDD ..	1,1-di(p-chlorophenyl)-2,2-dichloroethane	
DDE	1,1-di(p-chlorophenyl)-2,2-dichloroethylene	

Common name used	Chemical names or definitions	Other names
DDT [a,b]	a complex chemical mixture in which p,p′DDT [*q.v.*] predominates (The British Standard requires the percentage of p,p′DDT to be stated.)	dicophane, B.P. (75 per cent. p,p′DDT) chlorophenothane, U.S.P. (14 : 136. 1950)
p,p′DDT [b] ..	1, 1 - di (p - chlorophenyl) - 2, 2, 2 - trichloro - ethane	
demeton [a,b] ..	a mixture of demeton-O and demeton-S [*q.v.*]	
demeton-O [b] ..	O,O-diethyl O-2-(ethylthio)ethyl phosphorothioate	
demeton-S [b] ..	O,O-diethyl S-2-(ethylthio)ethyl phosphorothioate	
diazinon [b] ..	O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate	Diazinon [a]
dicapthon [a] ..	O,O-dimethyl O-2-chloro-4-nitrophenyl phosphorothioate	Am. Cyanamid 4124
dichlorvos [b] ..	dimethyl 2,2-dichlorovinyl phosphate	DDVP [a]
dieldrin [a,b,c] ..	not less than 85 per cent. HEOD [*q.v.*]	
dimefox [a,b] ..	bis(dimethylamino)fluorophosphine oxide	Hanane, Pestox 14
dimetan [a]	dimethyl 3-hydroxy-5,5-dimethyl-1-oxo-2-cyclohexenyl carbamate 5,5-dimethyldihydroresorcinol dimethylcarbamate	
dimethoate ..	O,O - dimethyl S - methylcarbamoylmethyl phosphorodithioate	Rogor
dimethyl carbate [a]	dimethyl ester of *cis*-bicyclo[2.2.1]-5-heptene-2,3-dicarboxylic acid	
dinex [b]	2,4-dinitro-6-cyclohexylphenol The British Standard recommends that salts or esters of this compound should be differentiated by the addition, following a hyphen, of the name of the combining substance, *e.g.*, dinex-sodium.	dinitrocyclohexylphenol [a],DNOCHP
dinosam [b]	2,4-dinitro-6-sec.-amylphenol Salts or esters to be cited as indicated under dinex.	
dinoseb [b]	2,4-dinitro-6-sec.-butylphenol Salts or esters to be cited as indicated under dinex.	dinitrobutylphenol [a]
DMC	1,1-di(p-chlorophenyl)ethanol di(p-chlorophenyl)-methyl-carbinol	Dimite [a]
DNC	3,5-dinitro-o-cresol [numbered with CH_3 as 1] 4,6-dinitro-o-cresol [numbered with OH as 1] Salts or esters to be cited as indicated under dinex.	DNOC [b], dinitrocresol [a]

Common name used	Chemical names or definitions	Other names
endothion [b] ..	2-(O,O-dimethyl phosphorothiolomethyl)-5-methoxy-4-pyrone	
endrin [a,b,c] ..	1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,-5,6,7,8,8a-octahydro-*exo*-1,4-*exo*-5,8-dimethanonaphthalene, according to the nomenclature of the Chemical Society, London 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,-5,6,7,8,8a-octahydro-*endo*-1,4-*endo*-5,8-dimethanonaphthalene, according to the nomenclature of the American Chemical Society	
EPN [a]	O-ethyl O-p-nitrophenyl phenylphosphonothioate	
ethion [a,b]	tetra-O-ethyl S,S′-methylene bisdithiophosphate O,O,O′,O′-tetraethyl S,S′-methylene bisphosphorodithioate	 Nialate
ethyl-DDD ..	a complex chemical mixture in which p,p′-ethyl-DDD [*q.v.*] predominates	Perthane [a], Q-137
p,p′ethyl-DDD	1,1-di(p-ethylphenyl)-2,2-dichloroethane	
ethyl hexanediol [a]	2-ethyl-1,3-hexanediol	Rutgers 612
fenson [b]	p-chlorophenyl benzenesulphonate	PCPBS, CPBS
ferbam [b,d]	ferric dimethyldithiocarbamate	
fluorbenside [b] ..	p-chlorobenzyl p-fluorophenyl sulphide	
fluoro-DDT ..	a complex chemical mixture in which p,p′-fluoro-DDT [*q.v.*] predominates	
p,p′fluoro-DDT	1,1-di(p-fluorophenyl)-2,2,2-trichloroethane	DFDT
furethrin [a] ..	*dl*-2-(2-furfuryl)-4-hydroxy-3-methyl-2-cyclopenten-1-one esterified with a mixture of *cis* and *trans* *dl*-chrysanthemic acids	
Genite [a]	2,4-dichlorophenyl benzenesulphonate	
glyodin [d]	2-heptadecyl-2-imidazoline acetate	
Guthion [a]	O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate	Gusathion, Bayer 17147
HEOD [b]	1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,-5,6,7,8,8a-octahydro-*exo*-1,4-*endo*-5,8-dimethanonaphthalene, according to the nomenclature of the Chemical Society, London 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,-5,6,7,8,8a-octahydro-*endo*-1,4-*exo*-5,8-dimethanonaphthalene, according to the nomenclature of the American Chemical Society	
heptachlor [a,b,c] ..	1(or 9),4,5,6,7,10,10-heptachloro-4,7,8,9-tetrahydro-4,7-*endo*methyleneindene 1(or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene	

Common name used	Chemical names or definitions	Other names
HHDN [b]	1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-*exo*-1,4-*endo*-5,8-dimethanonaphthalene, according to the nomenclature of the Chemical Society, London 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-*endo*-1,4-*exo*-5,8-dimethanonaphthalene, according to the nomenclature of the American Chemical Society	
isodrin [a,b,c] ..	1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-*exo*-1,4-*exo*-5,8-dimethanonaphthalene, according to the nomenclature of the Chemical Society, London 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-*endo*-1,4-*endo*-5,8-dimethanonaphthalene, according to the nomenclature of the American Chemical Society	
Isolan [a]	1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate	
Karathane [a] ..	2,4-dinitro-6-(1-methylheptyl)phenyl crotonate	
Kelthane [a] ..	1,1-di(p-chlorophenyl)-2,2,2-trichloroethanol	
lindane [a,c] ..	γ isomer of BHC [*q.v.*] of not less than 99 per cent. purity	
malathion [a,b,c] ..	O,O-dimethyl S-(1,2-di(ethoxycarbonyl)ethyl) phosphorodithioate	
maneb [b,d]	manganese ethylene-1,2-bisdithiocarbamate	
mazidox [b] ..	bis(dimethylamino)azidophosphine oxide	
methoxy-DDT ..	a complex chemical mixture in which p,p′-methoxy-DDT [*q.v.*] predominates	dianisyl trichloroethane
p,p′methoxy-DDT	1,1-di(p-methoxyphenyl)-2,2,2-trichloroethane	methoxychlor [a,b,c]
methyl-DDT ..	a complex chemical mixture in which p,p′-methyl-DDT [*q.v.*] predominates	ditolyl trichloroethane
p,p′methyl-DDT	1,1-di(p-methylphenyl)-2,2,2-trichloroethane	
methyl-demeton	a mixture of methyl-demeton-O and methyl-demeton-S [*q.v.*]	Metasystox, demeton-methyl [b]
methyl-demeton-O	O,O-dimethyl O-2-(ethylthio)ethyl phosphorothioate	demeton-O-methyl [b]
methyl-demeton-S	O,O-dimethyl S-2-(ethylthio)ethyl phosphorothioate	demeton-S-methyl [b]
methyl-parathion	O,O-dimethyl O-p-nitrophenyl phosphorothioate	parathion-methyl [b]
mipafox [b]	bis(monoisopropylamino)fluorophosphine oxide	Pestox 15, Isopestox
nabam [b,d] ..	disodium ethylene-1,2-bisdithiocarbamate	
Neotran [a]	di(p-chlorophenoxy)methane	

Common name used		Chemical names or definitions	Other names
paraoxon	..	diethyl p-nitrophenyl phosphate	E-600, para-oxon [a]
parathion [a,b,c]	..	O,O-diethyl O-p-nitrophenyl phosphorothioate	E-605
phenkapton [b]	..	O,O-diethyl S-2,5-dichlorophenylthiomethyl phosphorodithioate	
phorate [b] ..	..	O,O-diethyl S-ethylthiomethyl phosphorodithioate	Thimet [a]
Phosdrin [a]	..	dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate	
phosphamidon [b]	..	dimethyl 2-chloro-2-diethylcarbamoyl-1-methylvinyl phosphate	
piperonyl butoxide [a]		product containing as its principal constituent α-[2-(2-butoxyethoxy)-ethoxy]-4,5-methylenedioxy-2-propyltoluene	
piperonyl cyclonene [a]		mixture of 3-alkyl-6-carbethoxy-5-(3,4-methylenedioxyphenyl)-2-cyclohexen-1-one and 3-alkyl-5-(3,4-methylenedioxyphenyl)-2-cyclohexen-1-one	
Pirazinon [a]	..	O,O-diethyl O-2-propyl-4-methyl-6-pyrimidinyl phosphorothioate	
Potasan [a] ..	..	O,O-diethyl O-4-methyl-7-coumarinyl phosphorothioate	
Prolan [a] ..	..	1,1-di(p-chlorophenyl)-2-nitropropane	
propyl isome [a]	..	di-n-propyl 6,7-methylenedioxy-3-methyl-1,-2,3,4-tetrahydronaphthalene-1,2-dicarboxylate	n-propyl isome
Pyrazothion	..	O,O-diethyl O-3-methyl-5-pyrazolyl phosphorothioate	
Pyrazoxon	..	diethyl 3-methyl-5-pyrazolyl phosphate	
pyrethric acid	..	chrysanthemum dicarboxylic acid monomethyl ester	
Pyrolan [a] ..	..	1-phenyl-3-methyl-5-pyrazolyl dimethylcarbamate	
schradan [a,b]	..	bis(dimethylamino)phosphonous anhydride octamethyl pyrophosphoramide	OMPA
sesamex [a] ..	..	2-(2-ethoxyethoxy)ethyl-3,4-methylenedioxyphenyl acetal of acetaldehyde	Sesoxane
Sevin ..	..	1-naphthyl N-methylcarbamate	7744
siglure [a] ..	..	sec.-butyl 6-methyl-3-cyclohexene-1-carboxylate	
Strobane [a]	..	a mixture of chlorinated terpenes with a chlorine content of about 66 per cent.	
sulfotep [b] ..	..	tetraethyl dithionopyrophosphate	sulfotepp [a]

Common name used	Chemical names or definitions	Other names
sulfoxide [a] ..	1, 2 - methylenedioxy - 4 - [2 - (octylsulphinyl) - propyl]benzene	
Tedion [a]	2,4,5,4′-tetrachlorodiphenyl sulphone	
TEPP [a,b]	tetraethyl pyrophosphate	
Thanite [a] ..	mixture of fenchyl and isobornyl thiocyano-acetates	
Thiodan [a]	6,7,8,9,10,10 - hexachloro - 1,5,5a,6,9,9a-hexahydro - 6, 9 - methano - 2,4,3 - benzodi-oxathiepin-3-oxide	
thiometon [b] ..	O,O-dimethyl S-2-(ethylthio)ethyl phosphoro-dithioate	Ekatin
thiram [b,d] ...	bis(dimethylthiocarbamoyl) disulphide	
toxaphene [a,b,c] ..	chlorinated camphene having a chlorine content of 67–69 per cent.	
trichlorphon [b] ..	dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate	Dipterex [a]
Trithion [a]	O, O - diethyl S - p - chlorophenylthiomethyl phosphorodithioate	
zineb [b,d]	zinc ethylene-1,2-bisdithiocarbamate	
ziram [b,d]	zinc dimethyldithiocarbamate	

Laughlin (R.). **The rearing of crane flies (Tipulidae).**—*Ent. exp. appl.* **1** no. 4 pp. 241–245, 1 fig. Amsterdam, 1958. (With a summary in German.)

Tipula oleracea L. and *T. paludosa* Mg. can be reared in the laboratory by removing the head, wings and legs from fertilised females, to induce oviposition, floating the bodies on water in a dish containing a piece of filter paper, on to which the eggs sink, draining off the water and incubating the eggs on the damp filter paper in a special container consisting of two perspex plates separated by a rubber ring, one plate having a $\frac{1}{4}$-in. hole covered with gauze for ventilation, transferring the larvae to damp, drained sand dusted lightly and unevenly with dry powdered grass for food or (later) covered with lumps of this made into a paste, and keeping the pupae in holes in damp blocks of plaster of paris. Pupal development can be delayed and adult emergence synchronised by storage at low temperatures.

Beard (R. L.). **Secondary physiological effects of DDT in *Galleria* larvae.**—*Ent. exp. appl.* **1** no. 4 pp. 260–267, 3 pls., 7 refs. Amsterdam, 1958. (With a summary in German.)

DDT is relatively harmless to larvae of *Galleria mellonella* (L.) when applied externally, but is toxic to them on injection, the symptoms normally following a predictable pattern of jerky locomotion, convulsive movements, prolonged hyperactivity, weakness, loss of weight, and death, with no period of prostration such as occurs in some other insects. The muscles of late-

instar larvae are readily paralysed by the venom of *Bracon (Microbracon) hebetor* Say, and injection of DDT then causes no visible symptoms and does not hasten death, though the toxicant is still present in lethal amounts. Comparison of larvae treated with DDT alone or with injection of venom indicated that depletion of adenosine triphosphate (ATP) occurred only after death, and not directly or indirectly as a result of DDT treatment.

The course of DDT poisoning is sometimes modified, in that some larvae die before the emaciated stage resulting from continuous muscular activity is reached, and some regurgitate and become rigidly prostrate soon after the onset of convulsions. The first case is due to natural causes, but regurgitation is caused by the action of the DDT. The prostration is accompanied by a depletion of ATP and is a secondary effect of the DDT poisoning. Injection of ATP resulted in complete recovery in some cases.

Kennedy (J. S.), Lamb (K. P.) & Booth (C. O.). **Responses of *Aphis fabae* Scop. to water shortage in host plants in pots.**—*Ent. exp. appl.* **1** no. 4 pp. 274–290, 6 figs., 31 refs. Amsterdam, 1958. (With a summary in German.)

Although the impression prevails that drought favours the multiplication of aphids, the literature is not in agreement as to the relation of aphids to the water status of their food-plants. Feeding has been shown to depend on plant turgor, and investigations were therefore carried out in England with *Aphis fabae* Scop. on potted spindle plants (*Euonymus europaeus*) on a garden bench and on spindle and broad bean (*Vicia faba*) in the greenhouse. The following is the authors' summary of the results.

Water strain in the host plant reduced aphid feeding and larviposition and sometimes increased the proportion of winged offspring. These negative effects on the aphids occurred despite the enrichment of the phloem sap that could be inferred from the senescence and changing composition of the leaves under water strain, tended to obliterate the normal effects of leaf age, and were readily reversible. They are attributed to stimuli associated with a reduction in the quantity of sap obtainable by the aphids owing to reduced turgor pressure or increased sap viscosity. The opposite, positive effects recorded previously with various aphids may be associated with less severe or intermittent water strain in the plant when the reduced quantity of sap obtainable is more than compensated by its improved quality.

Stegwee (D.) & Ponsen (M. B.). **Multiplication of potato leaf roll virus in the aphid *Myzus persicae* (Sulz.).**—*Ent. exp. appl.* **1** no. 4 pp. 291–300, 1 graph, 21 refs. Amsterdam, 1958. (With a summary in German.)

The following is virtually the authors' summary. Insect-to-insect transmission of potato leaf-roll virus proved possible by injecting either juice or haemolymph from viruliferous examples of *Myzus persicae* (Sulz.) into virus-free ones. In serial transmission experiments, in which injection of haemolymph was practised, the virus could be carried through as many as 15 successive aphid-to-aphid passages without access of inoculated insects to any plants that are susceptible to leaf-roll. The theoretical dilution of original virus used for the inoculation in the 15th passage would have been approximately 10^{-21}. It is concluded that such persistence of virus in the aphids could only be explained on the assumption that the insect itself sustains reproduction of the virus.

Fu (Sheng-fa), Wan (Chang-sheo) & Tsao (Chih-yang). **Investigations on the control measures of the pink bollworm and their applications.** [*In Chinese.*]—*Acta oecon.-ent. sin.* **1** no. 1 pp. 1–17, 2 graphs, 54 refs. [Peking] 1958. (With a summary in English.)

Investigations on the distribution, bionomics and control of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) on cotton in China were begun in 1947. It was found that the bollworm was present in all the cotton-growing districts, except for a few in the north-west, and that the country was divisible into four areas according to the number of generations produced in the year, which varied from two to over four. In Nanking, there were three principal generations, but some of the second-generation larvae entered hibernation and a few fourth-generation individuals developed in cotton squares. Damage was related to numbers. The population of the first generation was at first limited by the scarcity of squares during the period of emergence of the overwintered moths, but increased rapidly after the appearance of bolls, which were the preferred food. Dry weather in August caused a decrease in numbers of the second generation. The desirability of control measures varies according to area. In two-generation districts, where the minimum temperature falls to -20°C. [-4°F.], the hibernating larvae are killed by the cold and control is unnecessary. Where there are 2–3 generations a year and the minimum temperature does not fall much below -12°C. [10·4°F.], mortality of hibernating larvae is high only outdoors, and control measures are necessary. Mortality is low where there are 3–4 generations, so that both winter and field control measures are required, and measures during both the growing period and harvest are desirable where there are more than four. Examples of the reductions in population achieved are given.

Hsü (Ming-shia), Chang (Guang-shio) & Chu (Hung-fu). **A study on the cotton bollworm,** *Heliothis armigera* **(Hübner) (Lepidoptera, Noctuidae).** [*In Chinese.*]—*Acta oecon.-ent. sin.* **1** no. 1 pp. 18–30, 4 figs., 53 refs. [Peking] 1958. (With a summary in English.)

The world distribution of *Heliothis armigera* (Hb.) is reviewed, and an account is given of investigations on its bionomics and control on cotton carried out in the Honan Province of China, mainly in 1954–56. There were normally three generations a year, but a fourth occurred in both laboratory and field in 1957. The adults appeared as early as late April, but did not become abundant until mid-June, and last-generation larvae were present in September. The adults lived for about 20 days, and the females laid over 1,000 eggs each, the maximum in the laboratory being 2,734. The egg, larval and pupal stages lasted 2–4, about 20 and (except for hibernating pupae) about 10 days, respectively, and a single larva often destroyed several fruits, the maximum recorded being 10 squares and bolls by one individual. The body colour of the larvae was variable, and four basic patterns were distinguished. When two larvae occurred in a boll, the larger one usually devoured the smaller. The control experiments showed that a 5 per cent. DDT dust and a 50 per cent. DDT wettable powder diluted 1 : 300 in water were the best treatments, giving complete kill after 3–4 and 1–2 days, respectively, though a poison bait of soy-bean cake containing BHC was very effective against last-instar larvae. Two applications at intervals of 5–7 days are recommended.

HWANG (K. H.) & others. **Studies on the biology and chemical control of the apple fruit borer,** *Carposina niponensis* **Walsingham (Lepidoptera, Carposinidae).** [*In Chinese.*]—*Acta oecon.-ent. sin.* **1** no. 1 pp. 31–66, 18 figs., 21 refs. [Peking] 1958. (With a summary in English.)

Carposina sasakii Mats. (*niponensis* Wlsm.) is one of the most important pests of apples in Liaoning and Shantung, the principal apple-growing provinces of China, and, together with *Cydia* (*Grapholitha*) *inopinata* (Heinr.), destroys about one-third of the annual crop in the former. The moth also occurs in four other provinces of China, in Japan and Korea [*cf. R.A.E.*, A **19** 602] and in the southern coastal parts of the Maritime Region of the Soviet Union, and it attacks numerous pome and stone fruits.

Observations on its bionomics in Liaoning in 1954–55 showed that *C. sasakii* passes the winter in the soil as a full-fed larva in a stout cocoon within 4 in. of the surface, over half the cocoons occurring within the upper inch and most of them being close to the trunks of the trees, except on hillsides. It had one complete and a partial second generation in the year. The overwintered larvae left the soil between the end of May and mid-July, and the adults to which they gave rise oviposited over 7–8 weeks, so that much overlapping of stages occurred. Eggs were present on fruits in the field from mid-June to the end of September, and full-fed larvae of the first generation left the fruits from mid-July onwards. The resumption of activity in spring was favoured by rainfall, occurring normally when the soil temperature reached 19°C. [66·2°F.] (air temperature 17°C. [62·6°F.]) and the soil humidity was above 10 per cent., but ceasing if the latter dropped to 3 per cent. After they had left the soil, the overwintered larvae spun new cocoons on the surface. They pupated in these after an average period of 4·2 days, and the pupal stage averaged 12·5 days. The corresponding periods for first-generation larvae were 2·5 and 8·2 days. The combined prepupal and pupal stages averaged 13–19 days for the overwintered generation at 19–25°C. [66·2–77°F.] and 12 days for the first generation, beginning from the time the larvae left the fruits. The adults were not attracted to light or to several common baits, and lived for an average of 5 days. The two sexes were equal in numbers, and the preoviposition and oviposition periods lasted 2·8–4·2 and 2–8 days, respectively, the latter being slightly longer for the overwintering than for the first generation. The numbers of eggs per female averaged 44 and 66 in the two generations, respectively, and the maximum was 227. The eggs were laid on the fruits, over 90 per cent. of them at the calyx end. Over 85 per cent. of the eggs hatched, in 5–10 days, and the larvae entered the fruits within a few hours, rejecting the skin, and tunnelled to the core, where they fed on the seeds and surrounding tissues. They became full-fed in 20 and 24 days in the two generations and then dropped to the ground. Many larvae remained in early and main-crop apples at harvest and left them in the packing premises, and some continued their development within the fruits into the following year, completing it if conditions were favourable.

Various insecticides were tested in sprays against the eggs and young larvae in the laboratory. Parathion (E 605) at 0·006–0·009 per cent. was very effective against the eggs, but nicotine was unsatisfactory. Lead arsenate was ineffective against the newly hatched larvae, and the best control of these was given by DDT at 0·12–0·5 per cent. in wettable-powder sprays and 0·125 per cent. in emulsions. A dust of 3–6 per cent. γ BHC applied to the soil gave good control of larvae leaving it in spring or entering it in summer. In tests of residual effectiveness, an emulsion spray of 0·0129 per cent. parathion was very toxic to the eggs for three days after application, less so after five days and ineffective after a week, but an emulsion

spray of 0·1 per cent. DDT gave complete kill of newly hatched larvae ten days after application.

Chung (Chi-chien) & Wei (Hung-chuen). **Some ecological factors affecting wireworm activities,** *Pleonomus canaliculatus* **Faldermann and** *Agriotes fusicollis* **Miwa.** [*In Chinese.*]—*Acta oecon.-ent. sin.* **1** no. 1 pp. 67–82, 7 graphs, 1 map, 24 refs. [Peking] 1958. (With a summary in English.)

Pleonomus canaliculatus (Fald.) and *Agriotes fuscicollis* Miwa are widely distributed in northern China and are the most important wireworms injuring food-crops there. The first occurs mostly in unirrigated soils in arid and semi-arid regions, and the second in irrigated fields. Their movements in the soil are regulated by temperature and soil moisture, *Pleonomus* moving towards the surface early in March and again in late September or October, after the summer heat, and *Agriotes* doing so rather earlier. Injury is favoured by spring rain. *Pleonomus* completes its development in three years or more, pupation occurring in August–September and the adults emerging in September. *Agriotes* pupates in early June, but its complete life-cycle is not known. Adults of *Pleonomus* overwinter in the soil and resume activity in April. The females lay their eggs in the upper 4 in. of soil, and young larvae were observed in mid-May. Cultural measures are recommended for control.

Lin (Pe-hsin). **A study of the large sweet-potato weevil,** *Alcides* **sp. (Coleoptera, Curculionidae).** [*In Chinese.*]—*Acta oecon.-ent. sin.* **1** no. 1 pp. 83–95, 2 pls., 8 refs. [Peking] 1958. (With a summary in English.)

In China, sweet potatoes are severely injured by *Alcidodes* (*Alcides*) sp. in the hilly regions of Fukien and on the coast of southern Chekiang. Observations on its bionomics showed that it attacks several other species of *Ipomoea* and also early soy beans, the larvae boring into the stems and causing the formation of galls and ultimately the death of the plants. There are several generations a year in and near Foochow, and the adult weevils overwinter in cracks in stones and rocks in the mountains, but in southern Fukien, where the climate is warmer, some do so on the plant and the larvae overwinter in the galls. Control is effected by hand-picking or trapping the adults, late planting, piercing the galls with pieces of wire or bamboo, or injecting BHC suspensions or derris extract into the galls to kill the larvae and pupae. Dusts or sprays of BHC or DDT give very good results.

Ghent (A. W.). **Mortality of overstory trembling aspen in relation to outbreaks of the forest tent caterpillar and the spruce budworm.**—*Ecology* **39** no. 2 pp. 222–232, 6 figs., 9 refs. Brooklyn, N.Y., 1958.

The following is based on the author's summary. A study was undertaken in 1950 to determine the relation of mortality of trembling aspen (*Populus tremuloides*) in the Lake Nipigon forest area of north-western Ontario to the outbreak of *Malacosoma disstria* Hb. that occurred there in 1933–38 [*cf. R.A.E.*, A **28** 418] and the influence of this mortality on the exposure, flowering and consequent susceptibility to *Choristoneura fumiferana* (Clem.), of understory balsam fir (*Abies balsamea*) [*cf.* **40** 303] and white spruce

(*Picea glauca*) later devastated by this Tortricid [*cf.* **42** 50]. Evidence of growth-ring suppression in living aspen indicated that the trees in this area had been moderately defoliated in 1936 and heavily defoliated in 1937 and 1938, and this finding was substantiated by contemporary reports in a local newspaper.

Evidence of damaged leaders and primary laterals of balsam-fir seedlings, caused by late-instar larvae of *C. fumiferana* dropping from the overstory trees [*cf.* **47** 283], indicated that populations of *C. fumiferana* increased rapidly during the 2–3 years before the earliest measured overstory defoliation in 1940. This places the probable initiation of their upsurge at a time that appears to coincide exactly with the period of heavy aspen defoliation by *M. disstria*. Aspen mortality began as early as 1918 at a place on the west shore of Lake Nipigon, near the centre of the outbreak of *C. fumiferana*, and in 1924 at one 40 miles to the south, near Black Sturgeon Lake, and appeared to be almost entirely attributable to breakage of the trunks by wind. Over 40 per cent. of the overstory had disintegrated in this way before heavy defoliation by *M. disstria* occurred, and over 50 per cent. had died before *C. fumiferana* reached outbreak proportions. Flowering histories of two ten-inch balsam firs in a study plot near Black Sturgeon Lake indicated that the initiation of staminate-flower production had coincided with the beginning of aspen overstory mortality, and that the progressive increase in flowering abundance had parallelled the progress of aspen mortality. Establishment of a shrub layer of mountain maple (*Acer spicatum*) was also found to have closely parallelled the progress of aspen mortality, a factor to which the absence of sucker reproduction of aspen in these stands may probably be attributed. The earlier suggestion that the progress of overstory elimination was accelerated by defoliation by *M. disstria* and that the succession of the coniferous component was hastened in this way [**39** 151] received no support from the observations. Although the latter do not contradict the suggestion that defoliation by *M. disstria* may have extended the area of balsam-fir and spruce forests susceptible to *C. fumiferana*, such a postulate seems to be unnecessary to account for the devastation of the mixed stands of balsam fir and aspen at Lake Nipigon.

Morris (R. F.), Cheshire (W. F.), Miller (C. A.) & Mott (D. G.). **The numerical response of avian and mammalian predators during a gradation of the spruce budworm.**—*Ecology* **39** no. 3 pp. 487–494, 2 figs., 24 refs. Brooklyn, N.Y., 1958.

The following is almost entirely the authors' summary. The study of the effects of predators on a given species of prey is concerned largely with the numerical response of predator populations to changes in the population density of the prey, and the functional response or change in the food-habits of the predators associated with the increasing or decreasing availability of a certain food. Both types of predator response are being measured during a long-term study on the population dynamics of *Choristoneura fumiferana* (Clem.) on balsam fir (*Abies balsamea*) in forest stands on the Green River watershed in northern New Brunswick. The present paper comprises a brief review of the numerical response of birds and mammals in 1947–56. In some of the stands under study, *C. fumiferana* reached outbreak proportions and killed trees during this period, whereas in others the increase was much less severe. A direct numerical response was shown by some birds and particularly by the bay-breasted warbler (*Dendroica castanea*), the blackburnian warbler (*D. fusca*) and the Tennessee warbler (*Vermivora peregrina*).

Some other warblers, namely the magnolia warbler (*D. magnolia*), the myrtle warbler (*D. coronata*) and the black-throated green warbler (*D. virens*), showed an inverse response, presumably due to competition with the species that showed a direct response. During the same period, the population of rodents and insectivores fluctuated independently of *Choristoneura* density; however, the decreased heights of the peaks in the cycles of the red-backed vole (*Clethrionomys gapperi*) and the deer mouse (*Peromyscus maniculatus*) may have been associated with a shortage of tree seed resulting from insect damage. Predators were of little control value during the outbreak. However, the direct numerical response of certain birds at least gives them one of the properties essential in regulation, and the continuation of the work should reveal whether such regulation occurs when *C. fumiferana* is fluctuating at its low, endemic level.

SMITH (B. C.). **Development, feeding habits, and predator-prey relations of insect predators of the balsam woolly aphid,** *Adelges piceae* **(Ratz.) (Homoptera: Adelgidae), recently introduced into Canada.**—*Canad. Ent.* **90** no. 8 pp. 441–449, 4 figs., 7 refs. Ottawa, 1958.

The following is largely the author's summary. Field and laboratory investigations in New Brunswick on insect predators introduced against *Chermes* (*Adelges*) *piceae* Ratz. on balsam fir [*Abies balsamea*] [*cf. R.A.E.*, A **47** 69] indicated that the development of *Aphidecta obliterata* (L.), *Cremifania nigrocellulata* Czerny, *Laricobius erichsonii* Rosenh. and *Scymnus* (*Pullus*) *impexus* Muls. is generally similar to that observed in Europe [*cf.* **42** 199, 250, 280; **45** 239; **48** 15]. *A. obliterata* attacked the aphid, *Mindarus abietinus* Koch, on the twigs of balsam fir in the field, and may attack the stages of *Chermes piceae* that cause gout disease [*cf.* **42** 263]. Larvae of *Cremifania*, *Laricobius* and *Scymnus* did not attack *Myzus persicae* (Sulz.) or *Pseudococcus* sp. in the laboratory. The value of the predators against *Chermes piceae* is limited because few of their stages attacked the crawlers or the sessile first-instar nymphs. In cage studies in the field, the larvae of the predators reduced the numbers of *C. piceae* appreciably when present before first-instar nymphs became abundant.

LLOYD (D. C.). **Studies of parasite oviposition behaviour. II.** *Leptomastix dactylopii* **Howard (Hymenoptera, Encyrtidae).**—*Canad. Ent.* **90** no. 8 pp. 450–461, 32 refs. Ottawa, 1958.

The following is largely the author's summary of this second paper of a series [*cf. R.A.E.*, A **45** 484], in which the problem of host preferences in *Leptomastix dactylopii* How., an Encyrtid parasite of third-instar nymphs and adults of *Planococcus citri* (Risso), is examined. A review of published field records indicates that the parasite is largely restricted to this mealybug. Laboratory experiments in which small numbers of mealybugs of different species were exposed to single parasite females in small containers showed that this is not the result of an oviposition response to specific releasing stimuli in the normal field host, since oviposition by 48-hour-old females was common in other species. This occurred in pure and mixed host cultures even when brief exposures of one hour were used. Under these conditions, oviposition was frequent in *Pseudococcus adonidum* (L.), but less so in *P. maritimus* (Ehrh.) and *Phenacoccus solani* Ferris. The parasite produced

negligible numbers of progeny in *Pseudococcus adonidum* and *P. maritimus*, but maintained its population in *Phenacoccus solani*. In accordance with conventionally recognised processes of host preference dynamics, the first two hosts are classed as unsuitable.

Processes of egg maturation and resorption in the parasite female were examined by confining mated females with no hosts, with *Planococcus citri*, or for varying periods first with *P. citri* and then with one or other of the two unsuitable hosts or with no host. It was found that egg resorption is associated with absence of hosts, that it rarely occurs in the presence of adequate populations of the normal field host (*P. citri*), and that it occurs on only a very minor scale in the sustained presence of unsuitable hosts. It is concluded that the periodic oviposition in hosts unsuitable for the development of progeny can be interpreted as serving to promote species survival, since the release or resorption of eggs is essential for continuous egg maturation. From this standpoint, the validity of classifying hosts as suitable and unsuitable is questioned. The bearing of the observations on the general problem of host specificity in entomophagous insects is briefly discussed.

Monteith (L. G.). **Influence of food plant of host on attractiveness of the host to Tachinid parasites with notes on preimaginal conditioning.**—*Canad. Ent.* **90** no. 8 pp. 478–482, 9 refs. Ottawa, 1958.

The following is largely the author's summary. In the further laboratory investigations described [*cf. R.A.E.*, A **45** 404], the food-plants of *Neodiprion lecontei* (Fitch) influenced the attractiveness of the larvae to the Tachinid parasites, *Sturmia* (*Drino*) *bohemica* (Mesnil) and *Ptychomyia selecta* (Mg.) (*Bessa harveyi* (Tns.)). The parasites preferred larvae of *N. lecontei* from jack pine (*Pinus banksiana*) to those from red pine (*P. resinosa*) when the selection was in response to chemotactile stimuli [*cf. loc. cit.*], but showed no preference between the odours of these larvae. Similarly, *Ptychomyia selecta* preferred larvae of *Pristiphora erichsonii* (Htg.) from western larch (*Larix occidentalis*) to those from *L. laricina*. The sawfly larvae thus have two sets of characteristics that influence host selection by Tachinid parasites, one inherent in the species and the other acquired from feeding on a particular species of tree [*cf.* also **47** 265]. Survival of *S. bohemica* was higher on larvae from jack pine, but no preimaginal conditioning to these larvae occurred in the parasites propagated on them.

Pickford (R.). **Observations on the reproductive potential of** *Melanoplus bilituratus* **(Wlk.) (Orthoptera: Acrididae) reared on different food plants in the laboratory.**—*Canad. Ent.* **90** no. 8 pp. 483–485, 9 refs. Ottawa, 1958.

The following is almost entirely the author's summary. The reproductive capacity of the migratory grasshopper, *Melanoplus bilituratus* (Wlk.), was shown in laboratory studies in Saskatchewan to be considerably higher than previously reported [*cf. R.A.E.*, A **44** 115]. An average of at least 20 egg-pods per female was produced when the grasshoppers were reared on lettuce, lettuce and bran, lettuce, bran and lucerne meal, wheat and wild mustard (*Sinapis arvensis* var. *pinnatifida* (*Brassica kaber* var. *pinnatifida*)), wheat and flixweed (*Descurainia sophia*), or mustard only. The highest average production, which occurred on the combination of wheat and flixweed, was

43·2 pods, or 873 eggs, per female. Combinations of wheat with flixweed or mustard resulted in the highest average fecundity (about 23–25 pods per female), whereas wheat and brome grass (*Bromus inermis*) alone resulted in the lowest (about 9–12). The number of adults per cage, which ranged from 7 to 58, appeared to have no effect on the number of pods laid.

Arrand (J. C.). **A new species of *Plagiognathus* from alfalfa in western Canada (Hemiptera: Miridae).**—*Canad. Ent.* **90** no. 8 pp. 497–500, 1 fig., 17 refs. Ottawa, 1958.

A Mirid of the genus *Plagiognathus* that damages lucerne in western Canada is described from adults of both sexes as *P. medicagus* sp. n., and characters are given for its separation from *P. obscurus* Uhl., with which it has previously been confused. It is recorded on various plants in British Columbia, Alberta, Manitoba, Saskatchewan and Montana.

Reid (R. W.). **The behaviour of the mountain pine beetle, *Dendroctonus monticolae* Hopk., during mating, egg laying, and gallery construction.** —*Canad. Ent.* **90** no. 9 pp. 505–509, 3 figs., 7 refs. Ottawa, 1958.

An account is given of observations on the processes of pairing, gallery construction and oviposition and on the sex ratio in *Dendroctonus ponderosae* Hopk. (*monticolae* Hopk.) [*cf. R.A.E.*, A **46** 263] in lodgepole pine (*Pinus contorta* var. *latifolia*) in the East Kootenay region of British Columbia in 1956–57. Young, recently emerged adults kept in sheets of fresh inner bark held between glass plates of which the edges were sealed with friction tape usually paired several times on the first day, once a day for the next few days and much less frequently after the females began ovipositing. After three successive matings, one female laid 57, 54 and 44 viable eggs, respectively. When the male was removed from the gallery soon after mating, the female was able to lay eggs in a second gallery without pairing again. Spermatozoa remained viable within the spermotheca for at least a year. Oviposition began 3–4 days after pairing, both in the observation galleries and in the field. In galleries less than 12 in. long, the number of eggs per inch was greatest in the middle portion, but in longer ones there was considerable variation. Unmated females constructed galleries more slowly than mated ones, and a few laid eggs, which were not viable. Males were about half as numerous as females both when emerging from caged logs infested during the previous season and in newly attacked logs.

Wylie (H. G.). **Observations on *Aphidecta obliterata* (L.) (Coleoptera: Coccinellidae), a predator of conifer-infesting Aphidoidea.**—*Canad. Ent.* **90** no. 9 pp. 518–522, 21 refs. Ottawa, 1958.

The observations recorded were made in the Vosges region of France in 1950–51 [*cf. R.A.E.*, A **42** 199] and formed part of the investigations preparatory to the introduction of predators into eastern Canada against *Chermes* (*Adelges*) *piceae* Ratz. [on balsam fir (*Abies balsamea*)]. In Europe, *Aphidecta obliterata* (L.) attacks *C. piceae* and *C. nordmannianae* Eckstein (*Adelges nüsslini* (Börner)) on fir (*Abies alba*) and also other conifer-infesting aphids. The observations mainly concerned individuals associated with *C. nordmannianae*, and the following is virtually the author's summary of the results.

Aphidecta obliterata has one generation a year in eastern France. The gravid female lays up to about 300 eggs on the bark and needles of infested trees, and the larvae hatch in about seven days and feed on all stages of *C. nordmannianae* except the sessile neosistens. Pupae are formed on the bark and needles, and adults emerge in about a week, usually late in June. The adults soon mate and disperse from the infested trees and do not return until the following spring. The population density of *A. obliterata* was not appreciably affected by other predators with which it was associated, but over half the pupae were parasitised by the Phorid, *Phalacrotophora berolinensis* Schmitz, and a smaller proportion by a Mermithid of the genus *Hexamermis* [*cf. loc. cit.*].

Guppy (J. C.). **Insect surveys of clovers, alfalfa, and birdsfoot trefoil in eastern Ontario.**—*Canad. Ent.* **90** no. 9 pp. 523–531, 24 refs. Ottawa, 1958.

The results are given of surveys of the insects associated with forage crops of red clover (*Trifolium pratense*), ladino clover (*T. repens*), alsike clover (*T. hybridum*), lucerne and birdsfoot trefoil (*Lotus corniculatus*) made in eastern Ontario in 1951–54, together with notes on the seasonal occurrence and abundance of those of most economic importance. Of the 27 injurious species collected, 26 attacked red clover, 12 alsike clover, 16 ladino clover, 14 lucerne and nine birdsfoot trefoil.

Of the species confined to red clover, the most numerous were *Dasyneura leguminicola* (Lint.) [*cf. R.A.E.*, A **43** 172], *Bruchophagus gibbus* (Boh.), *Tychius stephensi* Schönh. [*cf.* **40** 157] and *Systena frontalis* (F.). *D. leguminicola*, which was very destructive, especially in 1951 and 1952, prevents the florets from opening and the ovaries from developing, but is important only when the second growth is used for seed production; damage to the second growth was greatest when the first growth was cut later than the third week in June. *B. gibbus* was abundant in 1954 and infested many of the seeds in a sample of 1,000 flower heads examined in early September. *T. stephensi* caused only slight loss of seed; the adult weevils, which were most numerous from mid-June until August, fed on pollen grains in the unopened florets, and the larvae, of which only one infests each floret, fed on the developing seeds. The adults of *S. frontalis*, which were abundant in 1952–53 and in 1953 remained at peak level from late July until late August, fed on the upper surfaces of the leaves, especially those immediately below the flower heads, and sometimes also on the corolla, but damage was not severe.

Of the principal pests of lucerne, the commonest were *Adelphocoris lineolatus* (Goeze), *B. roddi* (Gussakovskiĭ) (*gibbus medicaginis* Kolobova) [*cf.* **47** 339], which was abundant in 1953 and infested 10 per cent. of the seeds in a sample from the second growth in a field in its third crop year, and *Empoasca fabae* (Harris), which was injurious only in 1952, when it damaged many fields. *A. lineolatus* overwintered in the lucerne in the egg stage, the nymphs hatched about mid-June, and the adults appeared in late June, reaching a peak in early July. They were usually abundant in the second growth until 10th July and present until early August. Nymphs of the next generation were present from late July throughout August. Two generations were produced in both 1952 and 1953.

The other relatively abundant pests occurred on all five crops and comprised *Macrosiphum* (*Acyrthosiphon*) *pisum* (Harris), which especially attacked red and alsike clovers, was usually present throughout the summer

but abundant only in late June and July or in August, and did not cause noticeable damage; *Melanoplus femur-rubrum* (Deg.) and *M. bivittatus* (Say) [*cf.* **40** 157], which were most numerous in 1954, but caused serious injury only in a field of birdsfoot trefoil, destroying or damaging about 5 per cent. of the pods; *Lygus* (*Liocoris*) *lineolaris* (P. de B.), the most destructive of the Mirids; and another Mirid, *Plagiognathus chrysanthemi* (Wolff), which was abundant on all the crops, but appears not to have been recorded as a pest in North America, though it is of importance in Czechoslovakia [*cf.* **37** 2]. The nymphs of this last hatched in early June, and the adults were present in July and August; there was only one generation a year.

Miccotrogus picirostris (F.) [*cf.* **43** 159], which is of importance on alsike clover in south-western Ontario, was found in eastern Ontario for the first time in 1953 and was abundant in nursery plots of ladino and alsike clovers in 1954. These two crops are not widely grown, and the weevil had probably been overlooked previously.

The most commonly collected predators were *Orius insidiosus* (Say), *Geocoris bullatus* (Say), *Nabis ferus* (L.), *Chrysopa* sp. and Coccinellids. Wild bees that visited the flowers of red clover, lucerne and birdsfoot trefoil are noted; leaf-cutting bees (*Megachile* spp.) were scarce.

SMITH (C. C.). **A note on the association of fall cankerworm** (*Alsophila pometaria* (**Harr.**)) **with winter moth** (*Operophtera brumata* (**Linn.**)) (**Lepidoptera: Geometridae**).—*Canad. Ent.* **90** no. 9 pp. 538–540, 3 figs., 4 refs. Ottawa, 1958.

Alsophila pometaria (Harris) and the introduced *Operophtera brumata* (L.) resemble each other and attack the same trees in Nova Scotia, where their bionomics and seasonal occurrence are also similar [*cf. R.A.E.*, A **44** 226]. The total numbers of females and the proportions represented by *A. pometaria* that occurred among samples collected from adhesive bands on red oak (*Quercus rubra*) and maple (*Acer*) at two places in each year from 1950 to 1957 are shown in a table. The relative abundance of *A. pometaria* varied considerably from year to year, but *O. brumata* was always much the more numerous [*cf.* **44** 227]. Females of *O. brumata* oviposited extensively in the empty egg shells of the previous generation of *A. pometaria* and also in those of *Malacosoma disstria* Hb. and *M. americanum* (F.). Some attempts at mating between *O. brumata* and *A. pometaria* were observed. A female of *O. brumata* transferred to the laboratory while apparently pairing with a male of *A. pometaria* subsequently laid several eggs that hatched, but the larvae did not survive.

FINLAYSON (L. R.) & FINLAYSON (T.). **Notes on parasites of Diprionidae in Europe and Japan and their establishment in Canada on** *Diprion hercyniae* (**Htg.**) (**Hymenoptera: Diprionidae**).—*Canad. Ent.* **90** no. 9 pp. 557–563, 12 refs. Ottawa, 1958.

In the course of work on the biological control of *Gilpinia* (*Diprion*) *hercyniae* (Htg.) on spruce in Canada, 96 species of primary and secondary parasites were reared from nearly 32 million cocoons of sawflies of nine species that feed on spruce or pine, collected in Europe or Japan, and from half a million eggs of *Neodiprion sertifer* (Geoffr.), collected in Europe during 1933–40 [*cf. R.A.E.*, A **25** 12; **43** 171]. Over half a million of the

cocoons were of *G.* (*D.*) *polytoma* (Htg.), and the species obtained from these have already been noted [*cf.* **25** 12]. Most of the cocoons, comprising all those of *Diprion nipponicus* Rohw. and *D. similis* (Htg.) and some of those of *N. sertifer*, were reared in bulk on stacked screen-bottomed trays in rooms, containing only one species each and kept at 22°C. [71·6°F.] and 80 per cent. relative humidity, into which the adults emerged and from which both sawflies and parasites were collected daily by means of suction equipment designed for the purpose; the sawflies were collected directly into jars of alcohol and the parasites into large cages or vials. The remaining cocoons were incubated in individual vials [*cf.* **25** 13].

The parasites obtained in largest numbers and the percentages of cocoons from which they were reared are given for nine host species from different countries in tables; none was reared from *G.* (*D.*) *abieticola* (D. T.), which was collected only in Rumania. Of the parasites from cocoons of *N. sertifer*, the most abundant were *Exenterus abruptorius* (Thnb.), *Aptesis basizona* (Grav.), *Lamachus eques* (Htg.) and *Lophyroplectus luteator* (Thnb.), all in material from Hungary, Czechoslovakia, Sweden and Estonia, and also *E. amictorius* (Panz.) in cocoons from Estonia; the main parasites from cocoons of *N. sertifer* from Japan were *Lophyroplectus* sp., *Sturmia* (*Drino*) sp., *E. abruptorius* and one recorded as *E. adspersus* Htg. [*cf.* **29** 294; **41** 57]. *A. subguttata* (Grav.) and *E. amictorius* were the commonest parasites from cocoons of *D. similis* from Poland. *Achrysocharella ruforum* (Krausse) and *Tetracampe diprioni* Ferrière were reared from the eggs of *N. sertifer*, which were collected from *Pinus sylvestris* in Sweden and Czechoslovakia and *P. nigra* in Hungary.

Of the 30 species of parasites released in eastern Canada, seven have already been recorded as established [*cf.* **29** 38; **41** 56; **43** 171]. In addition, *Aptesis subguttata* has been recovered from cocoons of *G. hercyniae* in Quebec.

Smirnoff (W. A.). **An artificial diet for rearing Coccinellid beetles.**—*Canad. Ent.* **90** no. 9 pp. 563–565, 1 fig. Ottawa, 1958.

Attempts to introduce Coccinellids into Morocco for the control of *Parlatoria blanchardii* (Targ.) on date palms [*cf. R.A.E.*, A **44** 8; **46** 296] were hampered by difficulties in rearing or obtaining their prey in sufficient quantities, and artificial diets were therefore investigated in an attempt to develop a satisfactory technique for mass rearing. The most successful was prepared by dissolving 1·3 g. agar, 16 g. cane sugar and 6 g. honey in 100 g. hot water, cooling to 35–38°C. [95–100·4°F.], and adding 4·5 g. royal jelly (emulsified in 20 cc. of the solution), 0·5 g. lucerne-flour yeast and 2 g. pulverised dry insects of species normally attacked by the Coccinellid to be reared. The mixture is stirred vigorously and cooled to 5°C. [41°F.] for storing. This diet was excellent for adults, but for the larvae of some species it needed supplementing with 3 parts of beef jelly and 1 part royal jelly. It should be offered on small pieces of white paper at 27–30°C. [80·6–86°F.] and 60–80 per cent. relative humidity; coloured paper, especially yellow or purple, is repellent. At the time of writing, 19 species, which are listed, had been successfully reared on artificial diet. Development was more rapid than under natural conditions, the adults were more active and mated more readily, and the life span was up to seven times as long. Petri dishes provided satisfactory rearing chambers, but gravid females fed exclusively on the artificial diet did not oviposit until transferred to larger cages containing a small twig of the plant on which the species normally occurs, when they did so readily. In addition to facilitating mass rearing in the

laboratory, the use of the diet eliminates the need for transporting injurious insects with the predators, to serve as food.

Frost (S. W.). **Insects captured in light traps with and without baffles.**—*Canad. Ent.* **90** no. 9 pp. 566–567, 1 ref. Ottawa, 1958.

The effectiveness of the Pennsylvania light-trap [*R.A.E.*, A **46** 223] was compared at State College, Pennsylvania, with that of a similar trap, but without baffles, in 1957. About twice as many insects were taken in the trap with baffles as in that without.

Williams (R. K.), Brazzel (J. R.) & Martin (D. F.). **The effect of certain organic insecticides on the mortality and oviposition of pink bollworm adults.**—*J. econ. Ent.* **51** no. 5 pp. 567–570, 2 graphs, 3 refs. Menasha, Wis., 1958.

The authors describe experiments, carried out at College Station, Texas, in June–September 1955, in which cotton plants growing in the field were sprayed with insecticides and caged within two hours with newly emerged adults of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.). After five days, the numbers of dead adults and of eggs were counted. The insecticides were applied at various concentrations in 2·5 U.S. gal. emulsion spray per acre, and comparison of the LD50's showed that endrin, Guthion, parathion, malathion and dieldrin were significantly more effective against the moths than DDT, and heptachlor and mixtures of toxaphene or dieldrin with DDT (4 : 2 and 1 : 2) significantly less so. Guthion and endrin were better than all other compounds, with no significant difference between them, but increasing the dosage caused a greater increase in effectiveness for Guthion than for endrin. At economic rates, only DDT, endrin, Guthion, and Guthion with DDT (1 : 3) killed high proportions of moths before oviposition could occur or inhibited oviposition so much that destructive larval populations did not develop. DDT at 2 lb. per acre caused 89 per cent. reduction in oviposition, and endrin at 0·25 lb. gave a similar result; 0·5 and 1 lb. Guthion or 4 lb. of the mixture of dieldrin with DDT (1 : 2) caused 99 per cent. reduction, and 1 and 2 lb. of the mixture of Guthion with DDT (1 : 3) 97 and 95 per cent., respectively, whereas recommended doses of aldrin, BHC and heptachlor had little effect.

Tao (Chia-hwa). **Field tests of insecticides against paddy borer in Taiwan from 1953–56.**—*J. econ. Ent.* **51** no. 5 pp. 571–573. Menasha, Wis., 1958.

Tests on the control of *Schoenobius incertulas* (Wlk.) on rice in Formosa by means of insecticides were carried out in 1953–56 and gave results largely agreeing with those already noticed for 1957 [*R.A.E.*, A **47** 339]. When emulsion sprays containing about 0·025 per cent. toxicant were applied to the second crop 2–3 times in August–October in 1953–55, endrin seemed rather more and aldrin and a mixture of parathion and malathion (1 : 1) less effective than parathion or dieldrin or than a wettable-powder spray of dieldrin, but all gave significant control and caused significant increases in yield. Similar results were obtained in tests on the first crop, treated in

March and May in 1955 and 1956, and on a delayed first crop and an intermediate crop in 1955. In a single test in 1956, three applications of 0·04 per cent. Guthion or diazinon in emulsion sprays made to the second crop in September and October were about as effective as similar applications of parathion. The relative effectiveness of the insecticides appeared to be influenced by the population density of the insect and by local climatic conditions and agricultural practices.

Ball (H. J.). **The effect of visible spectrum irradiation on growth and development in several species of insects.**—*J. econ. Ent.* **51** no. 5 pp. 573–578, 4 figs., 17 refs. Menasha, Wis., 1958.

The following is based almost entirely on the author's abstract. Nymphs of *Blattella germanica* (L.) and *Oncopeltus fasciatus* (Dall.) and adults of *Therioaphis maculata* (Buckt.) were exposed daily for short periods to light of wavelengths corresponding to various sections of the visible spectrum. Exposure of *Blattella* indicated that the longer wavelengths may interfere with normal growth, since the life span and mean weights decreased as the daily exposure time was increased. Daily exposure of *Oncopeltus* to the longer wavelengths resulted in an increase in the maturation period and in reductions in adult weight and in the number of nymphs reaching the adult stage. The tests with *Therioaphis* indicated that short daily exposures to the longer wavelengths reduced the production of young. The mechanism responsible for such growth inhibitions is discussed; preliminary tests with adults of *Periplaneta americana* (L.) showed no evidence that oviposition or other normal life functions were affected by way of the neurosecretory cells, which are situated dorsally in the brain, beneath a thin cuticle.

Nielsen (G. L.). **Biology of the McDaniel mite,** *Tetranychus mcdanieli* **McGregor in Utah.**—*J. econ. Ent.* **51** no. 5 pp. 588–592, 6 refs. Menasha, Wis., 1958.

Tetranychus mcdanieli McG., all stages of which are briefly described, has recently become a serious pest in orchards in Utah, having been collected on most kinds of fruit trees in all the major fruit-growing areas and on many weeds in the cover crops. Investigations on its bionomics [*cf. R.A.E.*, A **20** 85; **21** 337], begun in 1956, showed that orange-coloured adult females overwintered under the bark or in the soil at the base of the trees and began feeding in spring on young leaves on low branches or on weeds when conditions became suitable. They soon changed in colour to green, and began to oviposit within a few days under favourable conditions; they produced young of both sexes, indicating that some had been fertilised in the autumn. Temperature had a marked effect on reproduction, established populations remaining almost constant during cool periods.

Laboratory tests showed that the duration of development from egg to adult varied from 16·3 days at 20°C. [68°F.] to 6·3 days at 35°C. [95°F.] for the females and that there are probably 7–9 generations a year. There was a definite correlation between the minimum daily temperature and the number of eggs laid per day; temperature also had a marked effect on the duration of the preoviposition and oviposition periods and the total number of eggs laid per female, and the optimum for egg production appeared to be between 29 and 32°C. [84·2 and 89·6°F.]. The duration of development and of the preoviposition and oviposition periods were affected by the food-plant, as also were the number of eggs laid and the proportion of the mites that failed to reach maturity.

RAINE (J.) & ANDISON (H.). **Life histories and control of cherry fruit flies on Vancouver Island, British Columbia.**—*J. econ. Ent.* **51** no. 5 pp. 592–595, 11 refs. Menasha, Wis., 1958.

Both *Rhagoletis cingulata* (Lw.) and *R. fausta* (O.-S.) occur on Vancouver Island. *R. cingulata* is the principal pest of cultivated cherries, attacking most varieties, particularly late ones, but *R. fausta* has been reared from sour cherries only. Both attack the wild *Prunus virginiana* var. *demissa* (western chokecherry) and *P. emarginata* (bitter cherry). They have one generation a year and overwinter in the pupal stage in the soil below the trees. The females oviposit in the fruits about ten days after emerging, and the egg and larval stages last about five days and two weeks, respectively. Pupation occurs in the soil at depths of 2–4 in. Trapping tests showed that emergence of *R. cingulata* begins in mid-June, reaches a peak between 4th and 19th July and is mostly over by the third week of July, when picking is in progress. *R. fausta* emerged 3–4 weeks later than *R. cingulata* and did not become numerous. About 1·3 and 4 per cent. of the pupae formed in 1954 and 1955, respectively, overwintered a second time.

In control tests against *R. cingulata* in 1953, five applications of 4 lb. lead arsenate per 100 gal. at intervals of 7–10 days until 7–10 days before harvest reduced fruit infestation from about 50 to 1·3 per cent., but left a visible residue at harvest, and four of 1 pint 65 per cent. chlordane emulsion concentrate per 100 gal. were very effective, but left a residue above the legal tolerance. Other materials gave inferior results. In 1956, four applications of 2 pints 25 per cent. diazinon emulsion concentrate per 100 gal. at 10-day intervals from 15th June reduced infestation from 55 to 2·3 per cent. and apparently killed the larvae within the fruits as well as the adults. Residues were within the legal tolerance of 0·75 part per million a week after the last application. Emulsion sprays of chlordane, methoxy-DDT (methoxychlor), ethyl-DDD (Perthane) and malathion were not satisfactory.

ATKINS jr. (E. L.). **The garden tortrix,** *Clepsis peritana* **(Clemens): a new economic pest in southern California.**—*J. econ. Ent.* **51** no. 5 pp. 596–598, 3 figs., 1 ref. Menasha, Wis., 1958.

Ptycholoma (*Clepsis*) *peritana* (Clem.), a common pest of ornamental plants in southern California that was previously confused with other Tortricids, has caused increasingly serious damage to *Citrus* in uncultivated groves of recent years. The larvae feed mainly on decaying vegetable matter beneath the trees, but sometimes become so numerous that they attack sound fruits and foliage, up to 5 ft. above the ground. Combined attack by *P. peritana* and *Ephestia figulilella* Gregson was observed in several groves in Tulare County in 1950 and 1951, and *C. peritana* caused 25–40 per cent. of the damage, which was confined to fruits within 6–8 in. of the soil. Saprophytic species were also present.

Spraying the skirts of the trees with several common synthetic insecticides did not give enough protection to be recommended for control. A spray of 1·66 per cent. medium oil emulsion with 1 lb. cryolite per 100 U.S. gal., applied to cover the whole tree, practically eliminated *P. peritana* and also *Argyrotaenia citrana* (Fern.) from lemon trees in 2–4 weeks, and some organic insecticides applied at high pressure gave good control of the former on Valencia orange, but did not eliminate the larvae in leaf débris and mummified fruits under the trees, which form an important source of

reinfestation. Dislodging the débris with a spray of water at the beginning of July and again 6–8 weeks later protected navel oranges until the picking season, but additional treatments would be necessary for Valencia oranges. Picking the fruits round the skirt of the tree to a height of about 3 ft. in August, before damage occurred, prevented damage to ripe Valencia oranges, the main crop of which was picked in mid-September, and this was more effective than the removal of leaf débris, but a combination of the two treatments prevented damage to the next year's crop of green oranges in contact with the ground.

The larvae also attack lima beans, feeding on the blossoms and new leaf buds, but several applications of a dust of 10 per cent. DDT and sulphur at 30 lb. per acre reduced populations enough to keep damage at a minimum. On strawberry, they feed primarily on decaying vegetable matter round the crowns and on dead leaves at the base of the plants, but often attack the ripening fruits; some larvae were found damaging the berries in baskets in the market. Cutting off the old leaves close to the crown after each bearing cycle and raking up and burning all vegetable débris caused satisfactory reductions in population, but a dust of TEPP had to be applied every seven days to obtain uninjured fruits in one infested area.

Nielson (M. W.). **Reaction of seedling alfalfa to the spotted alfalfa aphid in southern Arizona.**—*J. econ. Ent.* **51** no. 5 pp. 601–603, 1 graph, 5 refs. Menasha, Wis., 1958.

Investigations on the reaction of lucerne seedlings to feeding by *Therioaphis maculata* (Buckt.) in southern Arizona in 1956 showed that the rate of plant destruction was in inverse geometrical proportion to the number of aphids. One aphid per plant and its progeny feeding and reproducing uncontrolled killed the plants in an average of 12·6 days, and this period decreased with increased numbers of aphids until it was 4·1 days for 15 and their progeny. When the number of aphids was restricted to the initial level, it decreased from 33·8 days for 1 aphid to 6·5 days for 15. The period to the death of the first plant varied under both conditions, but the range was much greater when the population was controlled, and the period between the deaths of the first and last plants was fairly constant when the population was not controlled, but varied widely when it was. Death of the plants was preceded by yellow vein clearing, chlorotic mottling and wilting [*cf.* *R.A.E.*, A **47** 16].

Knight (F. B.). **The effects of woodpeckers on populations of the Engelmann spruce beetle.**—*J. econ. Ent.* **51** no. 5 pp. 603–607, 4 figs., 5 refs. Menasha, Wis., 1958.

Three species of woodpeckers afford important control of *Dendroctonus engelmanni* Hopk. on Engelmann spruce [*Picea engelmanni*] in Colorado [*cf.* *R.A.E.*, A **44** 370], and a means of assessing their value was sought. Wire cages were placed round portions of the trunks of 225 infested trees, and the beetle populations that developed in areas of bark thus protected from woodpeckers or left unprotected were estimated. Woodpecker feeding was classified into five categories ranging from light to heavy by visual inspection of the damage to the bark. Analysis of the results showed that beetle survival was correlated negatively with woodpecker feeding and positively with the intensity of the insect infestation. Heavy woodpecker feeding resulted in very little survival at all intensities of infestation, and

the average reduction in population increased progressively from 45 to 98 per cent. as the woodpecker classification progressed from light to heavy; the numerical survival of beetles was greatest after moderate woodpecker feeding.

GOODARZY (K.) & DAVIS (D. W.). **Natural enemies of the spotted alfalfa aphid in Utah.**—*J. econ. Ent.* **51** no. 5 pp. 612–616, 7 refs. Menasha, Wis., 1958.

The following is substantially the authors' abstract. Predators of *Therioaphis maculata* (Buckt.) collected from lucerne fields near Delta, Utah, in 1956 comprised mainly Coccinellids, species of *Orius*, *Nabis*, *Geocoris*, *Collops* and *Chrysopa*, and Syrphids, most of which had fed on *Macrosiphum pisum* (Harris) until *Therioaphis* invaded the area in 1955. The efficiency of the predators depended on the availability of the aphid and on climatic conditions. The Coccinellids gave the most control and *Hippodamia convergens* (Guér.) was the most effective, numerous and widely distributed of them. *Orius* and *Collops* spp. were abundant enough in many areas to be of real importance. The predators undoubtedly afforded considerable control of *T. maculata* and they remained effective until insecticides were applied for the control of *Lygus*, after which they decreased in numbers and the aphid increased. Destruction of natural enemies contributed largely to this increase.

LILLY (J. H.) & others. **Thimet residues in small grains grown in treated soil.**—*J. econ. Ent.* **51** no. 5 pp. 623–625, 9 refs. Menasha, Wis., 1958.

The authors describe experiments in Iowa in which 40 per cent. phorate (Thimet) on powdered charcoal was mixed with fertiliser and applied at 1, 2 or 4 lb. actual compound per acre to the soil of plots subsequently sown with oats, wheat or barley, in order to see whether such treatment would by its systemic effect reduce the incidence of " blue dwarf " disease of oats, by killing a possible arthropod vector, and to study the residues present in the plants at various intervals after sowing. Inspection after the oats had headed showed no substantial reduction in the disease as a result of the treatments, and analysis of all three cereals revealed the presence of phorate or its metabolites 26–47 days after sowing but not after 68 or more days. The treatments caused no apparent damage to the plants.

MCEWEN (F. L.) & HERVEY (G. E. R.). **Control of the cabbage looper with a virus disease.**—*J. econ. Ent.* **51** no. 5 pp. 626–631, 3 figs., 17 refs. Menasha, Wis., 1958.

Of the pests of cruciferous vegetables in western New York, *Trichoplusia ni* (Hb.) is the most difficult to control, particularly since it became resistant to DDT there in 1953 [*cf. R.A.E.*, A **43** 235]. The polyhedral virus that infects the larvae [*cf.* **46** 427, etc.] was tested against it in 1957, and the following is based on the authors' summary of the results.

In laboratory tests, an oral dosage of 0·001 ml. of an inoculum prepared by triturating the body contents of one fifth-instar larva that had been killed by the virus in 16 l. water caused the infection and death of all the larvae treated. A smaller degree of infection was obtained by injection and by

topical application to the dorsal surface of the thorax, though in the latter case the insects may have contaminated their food and so received the virus by ingestion.

In field tests, larvae killed by the virus were triturated in water and applied to leafy vegetables at rates of 0·94–120 larvae in 30 U.S. gal. spray per acre. Infections that greatly reduced the larval populations were caused by all treatments, but increased dosage resulted in a more rapid progress of the disease. Storage of the inoculum at 0°F. for six months did not apparently reduce its pathogenicity, and application in a spray with TEPP or a spreader and adhesive had no adverse effects on it.

HENDERSON (C. A.), INGRAM (J. W.) & DOUGLAS (W. A.). **Insecticides for control of the sugarcane beetle on corn.**—*J. econ. Ent.* **51** no. 5 pp. 631–633, 3 refs. Menasha, Wis., 1958.

Euetheola rugiceps (Lec.) is an important pest of maize in the southern United States [*cf. R.A.E.*, A **43** 432], and investigations on the control of the overwintered adults, which attack the plants in spring, were begun in Mississippi in 1953. Seed treatment with 6 oz. aldrin, dieldrin, chlordane, heptachlor or lindane [almost pure γ BHC] per bushel failed to control the beetles, but when applied in a band, 6–8 in. wide, along the drill at sowing time or soon after the plants had appeared, 1 lb. aldrin or heptachlor per acre, in granules or sprays, proved effective and gave about equal control. Dieldrin was as effective as aldrin in a spray but not in granules, and Thiodan, Guthion, Chlorthion and Sevin at 1 lb. and phorate (Thimet) at 2 lb. per acre were ineffective. Control caused no increase in yield unless at least 25 per cent. of the untreated plants had been killed by the infestation.

Sprays applied at 15 U.S. gal. per acre did not scorch the young plants, and although the granules caused some injury when they fell into the whorls or leaf sheaths, the damage was not important. As infestation by *E. rugiceps* is often localised and difficult to predict, treatment can be delayed until the plants are 3–5 in. high if a heavy infestation is not apparent before that time.

NICKEL (J. L.). **Agricultural insects of the Paraguayan Chaco.**—*J. econ. Ent.* **51** no. 5 pp. 633–637, 2 figs., 9 refs. Menasha, Wis., 1958.

A survey of insects of agricultural importance was made from March 1955 to April 1956 in a remote part of the Paraguayan Chaco, where the climate is subtropical, with sporadic rainfall and extensive dry periods. The most important polyphagous pests found were leaf-cutting ants of the genus *Atta*, *Schistocerca paranensis* (Burm.) and *Tetranychus desertorum* Banks. Cotton is the principal crop grown. Of the insects that attacked it, *Alabama argillacea* (Hb.), *Heliothis zea* (Boddie), *H. virescens* (F.), *H. gelotopoeon* (Dyar), *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) and *Dysdercus pallidus* (Blöte) were the most important, *Oxycarenus hyalinipennis* (Costa) was present and possibly injurious, and *Aphis gossypii* Glov., *Gargaphia torresi* Costa Lima and *Niesthrea pictipes* (Stål) were of minor significance. Other insects were found occasionally on cotton. The leaves of groundnuts were attacked by Lepidopterous larvae, including *Spodoptera* (*Laphygma*) *frugiperda* (J. E. Smith) and *Anticarsia gemmatalis* Hb., late in the season, and also by thrips. *Citrus* was infested by a mite, *Brevipalpus phoenicis*

(Geijskes), and the fruits of both *Citrus* and guava were injured by various fruit-piercing moths. *S. frugiperda*, *Heliothis zea*, *Edessa meditabunda* (F.) and *Aphis* (*Rhopalosiphum*) *maidis* Fitch were taken on maize, thrips were observed damaging cowpeas, and *Prodenia eridania* (Cram.) injured sweet-potato foliage and migrated from it to adjacent cotton and groundnut crops.

IHNDRIS (R. W.) & SULLIVAN (W. N.). **Laboratory fumigation tests of organic compounds.**—*J. econ. Ent.* **51** no. 5 pp. 638–639, 1 fig., 4 refs. Menasha, Wis., 1958.

In view of the danger of the dissemination of harmful Diptera by aircraft, 78 organic compounds known to have insecticidal properties were tested as potential aircraft fumigants in laboratory tests against house-flies (*Musca domestica* L.). The flies in exposure jars were separated by wire gauze from an air-circulating device and a filter paper impregnated with an acetone solution of the compound to give a concentration of 50 parts per million with complete vaporisation. Under these conditions, five halogenated phosphorus compounds, dichlorvos (DDVP), diethyl 2,2-dichlorovinyl phosphate, dimethyl 2-chlorovinyl phosphate, dimethyl 1,2,2,2-tetrachloroethyl phosphate and Dow ET-57 (purified O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate) and three halogenated hydrocarbons, aldrin, heptachlor and γ BHC (lindane), caused complete knockdown in less than two hours and complete kill in 24 hours. Dichlorvos had the quickest action, giving complete knockdown in 25 minutes, but it has relatively high toxicity to mammals, with an oral LD50 for rats of 56–80 mg. per kg. ET-57 required 111 minutes for complete knockdown, but shows considerable promise because of its low toxicity to mammals (oral LD50 of 1·5–2 g. per kg. for rats), its freedom from odour and its high vapour pressure.

COWAN jr. (C. B.), PARENCIA jr. (C. R.) & DAVIS (J. W.). **Field tests with some of the new insecticides for control of the bollworm and a spider mite.**—*J. econ. Ent.* **51** no. 5 pp. 645–647, 3 refs. Menasha, Wis., 1958.

Further tests with Thiodan and initial tests with Sevin for the control of *Heliothis zea* (Boddie) on cotton were made in Texas in 1957 [*cf. R.A.E.*, A **46** 443]. Treatments were applied 7–9 times at about five-day intervals between mid-July and late August, and Thiodan at 0·7 lb. per acre in sprays or dusts was as effective as a spray affording about 2 lb. toxaphene and 1 lb. DDT per acre; it was less so at 0·5 lb. in sprays. Sevin was more effective at 2 and 1·6 lb. per acre in dusts than at 1 and 1·5 lb. per acre in sprays, which were about as effective as the spray of toxaphene and DDT. The Sevin sprays and also mixtures of 0·4 lb. Guthion and 0·8 lb. DDT per acre in sprays or dusts and of lime-free calcium arsenate, DDT and parathion in dusts all caused significant reductions in infestation, with no significant differences between yields, which were not usually increased significantly, because populations of *Anthonomus grandis* Boh. were unusually low and moisture available late in the season enabled untreated plants to recover from the early attack by *Heliothis*. Light infestation by *Trichoplusia ni* (Hb.) developed in one experiment on plants treated with materials other than endrin at 0·46 lb. per acre in a spray, which was as effective against *Heliothis* as the mixture of toxaphene and DDT.

Tetranychus desertorum Banks appeared on some plots, and single applications of sprays were tested against it in August. Examination a few

days later showed that parathion, amiton oxalate (Chipman R-6199), Guthion and diazinon at 0·25 lb. and Hercules AC-528 [2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)] at 0·5 lb. per acre gave good control and were equally effective, and that 1 lb. Kelthane gave poor and 0·5 lb. ethion or Trithion and 0·25 lb. hexaethyl ethylthiomethylidinetriphosphonate gave good initial control. There was some indication that amiton oxalate, Guthion and AC-528 might give longer-lasting results than parathion or diazinon.

Atkins jr. (E. L.). **The citrus cutworm,** *Xylomyges curialis* **Grote: economics, biology, and control.**—*J. econ. Ent.* **51** no. 5 pp. 653–657, 6 figs., 10 refs. Menasha, Wis., 1958.

Xylomyges curialis Grote has caused extensive damage to *Citrus* in several parts of California since 1934 [*cf. R.A.E.*, A **24** 174], injuring up to 90 per cent. of the new flush of growth, 80 per cent. of the newly set fruits and 50 per cent. of the ripening fruits in untreated groves. It has one generation a year, and the adults emerge from the overwintered pupae between late January and the beginning of May. Eggs are laid on the young *Citrus* foliage soon afterwards. The larvae hatch in 5–10 days and feed for 3–6 weeks, after which they pupate in earthern cells in the upper soil. If ten larvae per hour are found on examination of five sample trees or if ten per tree drop to the ground after spraying or dusting with DDT, control measures should be applied. In preliminary tests, sprays containing DDT, toxaphene, parathion, DDD, Dilan [a 1 : 2 mixture of Prolan and Bulan] and dicapthon all gave more than 95 per cent. reduction in numbers in a week on navel or Valencia oranges or grapefruit, and it is concluded that thorough spraying of the outside of the trees with 5 lb. actual DDT or DDD, 6 lb. toxaphene or 2 lb. parathion in 500 U.S. gal. water per acre gives adequate control of this Noctuid.

Jeppson (L. R.), Jesser (M. J.) & Complin (J. O.). **Factors affecting populations of the citrus bud mite in southern California lemon orchards and acaricide treatments for control of this Eriophyid.**—*J. econ. Ent.* **51** no. 5 pp. 657–662, 5 graphs, 4 refs. Menasha, Wis., 1958.

The following is based largely on the authors' abstract of this account of investigations on the changes in population of *Aceria sheldoni* (Ewing) over periods of 2–5 years in treated and untreated plots in four lemon orchards in southern California.

In untreated plots, a rapid increase in infestation in lemon buds began in May or June, and a maximum was reached in August or September. Populations remained high throughout the autumn and winter in some years but gradually decreased during the winter in others; in either case, populations fell to an annual minimum during April and May. These general trends were correlated with seasonal climatic changes and cycles of plant growth; warm summer weather favourable for plant growth and mite dispersal resulted in rapid increases in infestation, whereas winter conditions appeared to reduce movement from one bud to another. Periods of low relative humidity during winter or spring appeared to be major factors in the decline of infestation in the buds at that time. An unusually hot period in September 1955 resulted in a sharp decrease in infestation, especially in the orchard farthest from the coast. The summer increase in population was

about a month later under the fruit buttons than in the buds, but populations under the buttons were higher than bud populations during most of the year.

It was necessary to apply sprays of 1·75 per cent. oil emulsion or 2 lb. 15 per cent. wettable Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) per 100 U.S. gal. in both autumn and spring for adequate control, but Aramite was consistently less effective than the oil emulsion [*cf. R.A.E.*, A **40** 236]. Chlorobenzilate gave good control and was most effective when the spray was applied between the beginning of June and the end of September. It evidently left residues that were toxic to the mite throughout the dispersal period, since a single application of 1 lb. 25 per cent. wettable powder per 100 U.S. gal. during this period kept populations low for a year.

Patton (R. L.) & Sarkaria (D. S.). **The gross pathology of the American cockroach following injection with organic solvents.**—*J. econ. Ent.* **51** no. 5 pp. 663–665, 2 refs. Menasha, Wis., 1958.

The following is based on the authors' abstract and conclusions. Sub-lethal doses of organic solvents of various chemical categories were injected into the body cavities of young adults and nymphs of *Periplaneta americana* (L.), and a comparative study was made of the gross pathological changes of the tissues and organs that resulted. There was a striking similarity between the effects noted and those brought about by similar compounds in mammals. Compounds that cause kidney lesions in mammals damaged the malpighian tubes in the cockroaches, and those that cause liver degeneration led to fatty degeneration of the fat-body. In most cases, toxicity increased with the number of carbon atoms in the molecule. The results obtained show the importance of a careful study of the toxicity of solvents used as carriers for insecticides in studies of mode of action; they also indicate the possibility of selecting adjuvants that will enhance the activity of an insecticide by selective blocking of the organ in the insect that is responsible for detoxication.

Hightower (B. G.) & Martin (D. F.). **Effects of certain climatic factors on the toxicities of several organic phosphorus insecticides.**—*J. econ. Ent.* **51** no. 5 pp. 669–671, 6 refs. Menasha, Wis., 1958.

Laboratory tests were carried out in Texas in the late summer and autumn of 1956 to determine the independent effects of wind, rain and high temperatures on the toxicity of deposits of several organophosphorus compounds applied to cotton plants in emulsion sprays or dusts against *Anthonomus grandis* Boh., in comparison with chlorinated hydrocarbons, and the effects of wind and rain on those of emulsion sprays against *Tetranychus tumidus* Banks.

In the tests with *A. grandis*, the sprayed or dusted plants were infested with adults immediately after treatment, after 24 hours under laboratory conditions or after 24 hours during which they were subjected to 0·5 in. simulated rain applied in three minutes at the end of the period, a wind of 5 miles per hour for the whole of the period or a temperature of over 100°F. for four hours. Mortality counts were made after three days. Comparison of the results obtained with wind and rain applied to spray deposits showed that both reduced the toxicity of methyl-parathion and toxaphene, rain being the more important for methyl-parathion, that rain severely reduced that

of malathion and that neither had much effect on the loss of toxicity of Phosdrin, which was rapid at the prevailing laboratory temperature of 78–102°F. In a test with dusts under similar conditions, wind reduced the toxicity of Guthion, but had little effect on toxaphene and none on dieldrin, which lost toxicity fairly rapidly. Spray deposits of dieldrin, endrin, and Guthion exposed to the high temperature lost much of their toxicity, but the loss was much less for toxaphene.

In the tests with *T. tumidus*, which were carried out in a similar manner, wind reduced the toxicity of parathion at 70–100°F., but rain had little effect. Guthion lost toxicity rapidly under these conditions when applied at a low rate, and the loss was not affected by wind or rain, but retained toxicity better at a high rate of application, though rain reduced effectiveness. The results of rain were similar for Phosdrin. Rain after one hour reduced the toxicity of Guthion more than did rain after 24 hours, but there was little difference for parathion or Phosdrin. In a test with low rates of application, neither wind nor rain had much effect on parathion or methyl-parathion at 74–84°F., but rain reduced the effectiveness of Guthion.

Hamilton (D. W.) & Fahey (J. E.). **Effect of insecticides on codling moth larvae seeking cocooning quarters.**—*J. econ. Ent.* **51** no. 5 pp. 672–673, 1 fig., 2 refs. Menasha, Wis., 1958.

The possibility of spraying the trunks and scaffold branches of apple trees and the ground débris beneath them with insecticides to kill larvae of *Cydia* (*Carpocapsa*) *pomonella* (L.) searching for places in which to spin their cocoons was investigated in Indiana in 1955–57. Laboratory tests, by methods that are described, showed that sprays of 2 lb. 25 per cent. wettable diazinon or 15 per cent. wettable parathion or 1·5 lb. 25 per cent. wettable Guthion per 100 U.S. gal. left deposits that were effective against full-fed larvae, 1–2 lb. 50 per cent. wettable Sevin was less toxic and 1–1·5 U.S. pints 19·5 per cent. emulsifiable endrin was ineffective. Parathion, Sevin and Guthion appeared to repel the larvae, but did not do so in the field. In orchard tests, the stumps of apple trees were sprayed with 2 lb. 15 per cent. wettable parathion or Guthion per 100 U.S. gal. and full-fed larvae confined on the bark within metal collars at various intervals after treatment. Both materials killed more than 90 per cent. of the larvae immediately after application, and the parathion residues left after 3 and 13–20 days killed 86 and about 57–70 per cent., respectively, but Guthion lost its effect more rapidly. Spray deposits were heavier and more persistent on the bark than on leaf surfaces, decreasing by about half in 34 days.

McGarr (R. L.) & Chapman (A. J.). **Guthion and a DDT-endrin mixture for control of the pink bollworm.**—*J. econ. Ent.* **51** no. 5 p. 673. Menasha, Wis., 1958.

In tests on the control of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) on cotton, made in the Lower Rio Grande Valley of Texas in 1957, emulsion sprays were applied at 5 U.S. gal. per acre, 6–9 times at about weekly intervals, usually with a ground machine, but by aeroplane if the fields were too wet for ground equipment. Weekly examination showed average seasonal infestations of 24·1 per cent. infested bolls and 0·46 larvae per boll in plots receiving 0·53 lb. Guthion per acre, 32·5 per cent. infested bolls and 0·62 larvae per boll in those receiving 2 lb. DDT with 0·52 lb. endrin, and 67·6 per cent. infested bolls and 2·07 larvae per boll in untreated plots, with corresponding yields of 1,488, 1,840 and 800 lb. seed cotton per acre. Endrin

was not included in the first two applications in two of the four replicates. Boll rot, due to the entry of fungi and water through the exit holes made by the larvae caused considerable losses in the untreated plots.

HODGES (R.) & GUYER (G.). **The effects of an irradiated wheat diet on the confused flour beetle, granary weevil and the Angoumois grain moth.**—*J. econ. Ent.* **51** no. 5 pp. 674–675, 7 refs. Menasha, Wis., 1958.

In experiments to determine whether grain irradiated with cathode rays in a Van de Graaf accelerator [*cf. R.A.E.*, A **44** 272] differed from untreated grain as a food for *Tribolium confusum* Duv., *Calandra* (*Sitophilus*) *granaria* (L.) and *Sitotroga cerealella* (Ol.), wheat irradiated at 10,000, 100,000 or 1,000,000 rep had no apparent deleterious effect on the reproduction potential of insects reared on it. When differences did exist, an increase in reproduction was evident.

SIMANTON (W. A.). **Studies of Mediterranean fruit fly lures in Florida.**—*J. econ. Ent.* **51** no. 5 pp. 679–682, 3 figs., 3 refs. Menasha, Wis., 1958.

The following is substantially the author's abstract. The programme to eradicate *Ceratitis capitata* (Wied.) from Florida [*cf. R.A.E.*, A **47** 378, etc.] required very efficient trapping methods to detect the few remaining examples, and as the seed oil of angelica [*Archangelica officinalis*], which is considered the best lure [*cf.* **46** 349] is scarce, two synthetic compounds, siglure and its isopropyl homologue [isopropyl 6-methyl-3-cyclohexene-1-carboxylate], were used to supplement it [*cf.* **47** 184]. Observations on the volatilisation of these under summer and winter conditions in Florida led to modifications of vaporisers and dosages that greatly improved trapping. A 2-in. length of cotton dental roll, ¾ in. in diameter, proved a satisfactory vaporiser for siglure, and a dose of 9 ml. was effective for two weeks in the field. Partly wrapping the roll in aluminium foil permitted the more volatile isopropyl compound to be used at the same rate, and a similarly wrapped roll became the preferred vaporiser for angelica oil. For the most economical use of the latter, adjustment of initial and renewal dosage is necessary to compensate for variations in the volatility and attractive power of different samples. The toxicant used with all three materials was dichlorvos (DDVP) [*cf.* **46** 350].

KOEHLER (C. S.), MUKA (A. A.), GYRISCO (G. G.) & EDMONDS (C. M.). **Studies on the control of the alfalfa snout beetle larva.**—*J. econ. Ent.* **51** no. 5 pp. 682–685. Menasha, Wis., 1958.

Otiorhynchus (*Brachyrhinus*) *ligustici* (L.) has a life-cycle of two years, most of which is spent in the soil as a larva; this stage causes serious damage to the roots of lucerne and red clover [*Trifolium pratense*]. The adult, which lives a relatively short time, causes little injury and is the stage most readily killed, but control is not usually achieved until the crop has been severely damaged by the larvae. Investigations on the control of the latter and the protection of the growing crop were therefore begun in New York in 1951.

Laboratory tests showed that few of the insecticides selected were more than slightly toxic to late-instar larvae; parathion, isodrin and γ BHC gave some mortality when mixed with the soil at 10 parts per million (about 10 lb.

per acre to a depth of 3 in.), but other materials were ineffective, and it is concluded that this stage is difficult to kill at practical rates of insecticide application. In further tests, isodrin at 15–35 and γ BHC and parathion at 35 p.p.m. affected adults, which have to pass through the soil to oviposit, in a week or less, and in 1 per cent. emulsion, parathion gave high mortality of the eggs and heptachlor was almost as good, whereas chlordane and dieldrin were less effective. These results indicated that reductions in larval populations observed in the field after the application of insecticides are due largely to the destruction of eggs and adults; very young larvae are believed to be susceptible to insecticides, but the results of tests were inconclusive.

In field experiments, treatment of the soil of a lucerne field with 20, 40 or 50 lb. aldrin, dieldrin or heptachlor per acre as dusts in June of the year of sowing virtually eliminated the weevil by October of the following year and resulted in an average of four times as many plants as in untreated plots; 5–10 lb. aldrin or dieldrin gave effective but not complete control in dusts, and 3 lb. dieldrin or heptachlor and 5 lb. aldrin gave good and 1 lb. dieldrin or 3 lb. aldrin poor control in granules. The application of dieldrin at 1–5 lb. per acre in granules before growth began in spring resulted in detectable residues on the plants at the first cutting, but not at the second, probably as a result of splashing from the soil.

Barnes (M. M.) & Osborn (H. T.). **Attractants for the walnut husk fly.**—*J. econ. Ent.* **51** no. 5 pp. 686–689, 1 fig., 13 refs. Menasha, Wis., 1958.

In tests of the effectiveness of ammonium carbonate as a bait for *Rhagoletis suavis completa* Cress. on walnut in California, a pan containing a solution of glycine and sodium hydroxide [*cf. R.A.E.*, A **47** 431] caught about four times as many adults in 19 days as a trap consisting of a cylindrical carton lined with adhesive, with its end perforated and covered with a cap containing powdered ammonium carbonate, hung open end down. The latter became less effective after ten days, and increasing the quantity of ammonium carbonate from 10 to 40 g. did not improve the results. If installed in sufficient numbers at the right time, ammonium-carbonate traps would be very effective for surveying the distribution of the fly, but they would be less useful for determining initial emergence, because of the rapid loss of attractive power. The sexes were attracted equally to them. Diammonium azelate was initially more attractive than ammonium carbonate, but its effect declined more rapidly. Diammonium succinate was slightly less effective; and diammonium adipate and diammonium malonate were of little use. The sticky trap itself was not attractive.

In tests of other types of dry traps baited with ammonium carbonate, a cardboard tube lined with adhesive and hung horizontally was twice as effective as the inverted carton; and a plastic horizontal trap was ineffective [*cf.* **46** 350]. When used in the adhesive carton, oil of angelica seed [*Archangelica officinalis*] attracted nearly twice as many adults as siglure [*cf.* **48** 29], but anisyl acetone and methyl eugenol had little effect; the percentages of males in the catches were 97, 80, 74 and 90, respectively.

Apple (J. W.), Strong (F. E.) & Raffensperger (E. M.). **Efficacy of insecticidal seed treatments against wireworms on lima beans and corn.**—*J. econ. Ent.* **51** no. 5 pp. 690–692, 7 refs. Menasha, Wis., 1958.

Small-plot tests were carried out in Wisconsin to evaluate insecticidal seed treatments for the protection of lima beans from *Limonius agonus* (Say) in

1953 and dent maize from *Agriotes mancus* (Say) and *Melanotus* sp. in 1956 and 1957. The seeds were treated with slurries containing insecticide and fungicide as wettable powders in methyl-cellulose solution and sown within four weeks. Lindane [almost pure γ BHC] at 0·25–1 oz., dieldrin, heptachlor and aldrin at 0·5–2 oz., chlordane at 1–2 oz., parathion at 0·5 oz. and EPN at 0·5–1 oz., all with 1·33 oz. 75 per cent. thiram per 100 lb. lima-bean seed, caused an average mortality of 45 per cent. of wireworms feeding in the row 18 days after sowing and average gains of 61·6 per cent. in plant stand and 36·4 per cent. in whole plant weight at harvest. No advantage was obtained by using the first four insecticides at more than 0·5 oz.; they appeared to be more toxic to the wireworm than the other materials, but gave no advantage in final stand and plant weight. When maize seed was treated with 0·1–0·25 oz. heptachlor, dieldrin or aldrin and 1 oz. 75 per cent. captan per bushel, there were averages of 5·8 per cent. increase in stand and 5·7 per cent. increase in yield, with no significant differences between the three insecticides or the two dosages. These gains represented only 52·7 and 25·7 per cent., respectively, of those obtained by treating the soil surface with 1·5 lb. heptachlor per acre in emulsion spray and raking it in.

Barnes (M. M.). **A strain of codling moth in California resistant to DDT.**—*J. econ. Ent.* **51** no. 5 pp. 693–694, 1 graph, 9 refs. Menasha, Wis., 1958.

Very poor control of *Cydia* (*Carpocapsa*) *pomonella* (L.) with DDT, but adequate control with compounds not related to it, was obtained in an apple orchard in northern California in 1957 [*R.A.E.*, A **47** 419]. A colony was reared from overwintering larvae collected in this orchard and compared in its third generation with a non-resistant laboratory strain. Apples were sprayed with the LC50 for newly hatched larvae of the non-resistant strain (1·2 g. 50 per cent. wettable DDT per litre), and sprayed and unsprayed fruits were infested with newly hatched larvae of both strains by a cell technique [**47** 433]. The spray caused 50·1 and 17·2 per cent. reduction in fruit entries by the non-resistant and orchard strain, respectively, and tests with the eighth generation of the latter showed that it had an LC50 of 4·5 g. 50 per cent. wettable DDT per litre and that its resistance had been maintained through at least five generations. Attempts to develop a resistant strain from the standard non-resistant strain by rearing it from 1950 to 1954 on apples dipped in a suspension of wettable DDT were unsuccessful, indicating that the capacity to develop resistance was not present in the original population or that the level of selection (60–70 per cent.) was too low.

The development of a high level of resistance to DDT appears to have been confirmed in very few populations [**42** 399; **44** 384; **45** 113; **46** 58] in comparison with the large number of orchards in which the moth has been exposed to a high degree of selection for 12–24 or more generations, but a tendency for control to be somewhat more difficult to obtain with DDT is widespread, suggesting that at least some tolerance to DDT occurs widely.

Adkisson (P. L.). **Seed treatment of cotton with systemic insecticides alone and in combination with a fungicidal treatment.**—*J. econ. Ent.* **51** no. 5 pp. 697–700, 6 refs. Menasha, Wis., 1958.

In small-plot tests in Missouri in 1957, treatment of cotton seed with 3·5 lb. phorate (Thimet) or 4 lb. Bayer 19639 [O,O-diethyl S-2-(ethylthio)-

ethyl phosphorodithioate] per 100 lb., not more than a week before sowing in late April, treatment with a fungicidal spray affording 5 U.S. quarts nabam per acre applied to the seed in the furrow and combinations of the two were compared with a combination of the nabam treatment and a spray of 1 lb. toxaphene in 2 U.S. gal. emulsion spray per acre applied on 7th and 27th May for their effects on insect infestation early in the season. The systemic seed treatments (with and without nabam) and the toxaphene sprays gave effective control of thrips until early June, and the fungicide alone had no effect. Bayer 19639 appeared to give slightly better control of aphids than phorate, and both exerted some effect until mid-August. Some serious reductions in plant stand that occurred were apparently due to the low rate of flow of treated seed through the drill [*cf. R.A.E.*, A **46** 425] and low germination of treated seed in cool wet soil, and better results were obtained with phorate under warm conditions conducive to germination; the drill should be calibrated to compensate for the retarded flow of treated seed under field conditions. The addition of the fungicide treatment resulted in much better stands and reduced the phytotoxic effects of both phorate and Bayer 19639. Yields were not increased by any of the treatments, and the maturation of plants from treated seed was considerably delayed.

Agrawal (N. S.), Hodson (A. C.) & Christensen (C. M.). **Development of granary weevils and fungi in columns of wheat.**—*J. econ. Ent.* **51** no. 5 pp. 701–702, 5 refs. Menasha, Wis., 1958.

Tests with small quantities of stored wheat showed a biologically significant association between *Calandra* (*Sitophilus*) *granaria* (L.) and fungi that cause deterioration of stored grain [*R.A.E.*, A **46** 442]. Further experiments were therefore made with larger quantities of grain, and the following is substantially the authors' summary of the work.

Wheat containing 11–12 per cent. moisture was stored in cylinders 6 in. in diameter and 36 in. tall, adults of *C. granaria* were introduced and grain samples were removed at intervals for up to seven months and examined for moisture content, fungi and number of insects. Free adults introduced at the bottom of the column gradually moved to the top, and the portion of the grain in which they reproduced showed an increase in moisture content and fungi. When the weevils were introduced into grain of 15 per cent. moisture content in cloth bags and these were put at the bottom of columns of grain containing 11–12 per cent. moisture, both moisture content and fungi increased greatly in the grain in which the insects were confined, appreciably in that 6 in. above them and slightly in that 12 in. above. It seems probable, therefore, that a localised infestation by *C. granaria* may initiate and promote deterioration by storage fungi in a mass of grain considerably larger than that in which the insects are developing.

Daniels (N. E.) & Porter (K. B.). **Greenbug resistance studies in winter wheat.**—*J. econ. Ent.* **51** no. 5 pp. 702–704, 1 graph, 3 refs. Menasha, Wis., 1958.

The following is substantially the authors' abstract. A method is described for testing winter-wheat hybrids for resistance to *Toxoptera graminum* (Rond.). Tests of 1,026 F_2 plants grown from crosses of resistant and susceptible plants showed considerable resistance in 28, and these were grown to maturity in the greenhouse. The F_3 families grown from them were compared with 190 unselected F_3 families, and the high proportion of

resistant families obtained from the resistant F_2 plants indicated progress in selection. The results suggest that resistance is controlled by a single factor pair with susceptibility dominant to resistance [*cf. R.A.E.*, A **45** 357], although other modifying genes may be involved.

STRONG (F. E.) & APPLE (J. W.). **Studies on the thermal constants and seasonal occurrence of the seed-corn maggot in Wisconsin.**—*J. econ. Ent.* **51** no. 5 pp. 704–707, 1 graph, 9 refs. Menasha, Wis., 1958.

The following is based on the authors' abstract. The thermal constants [*cf. R.A.E.*, A **23** 296] for the various stages of development of *Hylemyia cilicrura* (Rond.) were investigated in Wisconsin. The threshold of development was determined as about 50°F., and observations on eight insectary cultures showed the thermal constants for egg, larval and pupal development to be 46, 236 and 287 day-degrees F., respectively. For complete development from egg to adult the constant was 572·5 day-degrees F. in the insectary and 600·7 in the field. The theoretical number of generations during 1957 was 5·26, and four complete and two partial generations were observed in the field; the preoviposition period was 2–3 days. The probability of aestivation during the hotter summer months appeared to be slight.

MISTRIC jr. (W. J.). **Trithion and ethion for control of two-spotted spider mite on cotton.**—*J. econ. Ent.* **51** no. 5 pp. 710–712, 10 refs. Menasha, Wis., 1958.

Tetranychus telarius (L.) was an important pest of cotton in North Carolina in 1957, and investigations on its control were continued [*cf. R.A.E.*, A **47** 24]. Fields that had received chlorinated hydrocarbons at regular intervals until 5th August against insect pests were treated against the mite as soon as the leaves began to redden; at that time, the mite population increased 6- to 10-fold in eight days in untreated plots and completely defoliated the plants within three weeks. In emulsion sprays and dusts, applied on 15th and 22nd August, respectively, ethion at about 1 lb. per acre caused 95·4 and 75·4 per cent. and Trithion at about 0·25 lb. caused 97·5 and 94·9 per cent. average reduction of mites in 4–12 days and were more effective than three applications, at four-day intervals, of 0·86 lb. Aramite [2-chlorethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) or 0·27 lb. parathion per acre in sprays and 0·75 lb. Aramite or 0·25 lb. parathion in dusts. A spray affording 0·25 lb. demeton per acre also gave good control, and it is concluded that this, the ethion spray and the Trithion spray and dust are sufficiently effective in a single application, but that a second application of ethion dust might sometimes be necessary.

CLEVELAND (M. L.). **Field studies in the control of orchard mites in 1957.**—*J. econ. Ent.* **51** no. 5 pp. 713–714, 2 refs. Menasha, Wis., 1958.

In experiments in Indiana in 1957, apple trees heavily infested with overwintering eggs of *Panonychus ulmi* (Koch) were used to compare early-season sprays of acaricides against this mite. A dormant application of DNC and oil emulsion had little effect, but a green-tip application of oil emulsion or 1–3 applications between 19th April (pink-bud stage) and 20th May (second cover spray) of other materials were effective for at least 60

days after petal fall. Fenson, at 0·25 and 0·5 lb. 50 per cent. wettable powder per 100 U.S. gal. in the calyx and second cover sprays, was the best, reducing the population to 0·18 per leaf on 25th June, when untreated trees showed 14·4. Single applications of Tedion at the pink or phorate (Thimet) at the calyx stage and 2–3 applications of chlorfenson (ovex) resulted in fewer than 2 active mites per leaf, and single applications of chlorbenside, Genite or schradan, 1–2 of amiton oxalate (Chipman R-6199) or demeton and two of phorate in fewer than 1.

Summer treatments were compared on trees that had a well distributed population of both *P. ulmi* and *Tetranychus telarius* (L.), and it was found that single applications of 2 lb. 25 per cent. wettable Kelthane, 2·5 lb. 15 per cent. wettable Guthion or 1 lb. 25 per cent. wettable Hercules AC-528 [2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)] per 100 U.S. gal., made in early July, reduced the numbers to less than 1 per leaf after 28 days, when untreated trees had 66 per leaf and those receiving Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], amiton oxalate, chlorobenzilate, demeton, ethion, phorate or Trithion had 1–4. Standard and experimental wettable formulations of chlorfenson had a less durable effect, but two applications of the standard formulation gave excellent control.

O'Brien (R. D.), Thorn (G. D.) & Fisher (R. W.). **New organophosphate insecticides developed on rational principles.**—*J. econ. Ent.* **51** no. 5 pp. 714–718, 1 graph, 18 refs. Menasha, Wis., 1958.

The low toxicity of malathion to mammals is probably due to the vigorous hydrolytic degradation of the compound or of its metabolite, malaoxon, in the liver [*cf. R.A.E.*, A **46** 179]. This is believed to occur at the carboxylic-ester bond, and it was thought that the introduction of such a bond into an organophosphorus anticholinesterase would confer selective toxicity towards insects as compared with mammals, that this effect would be strongest when the carboxyester group was close to the phosphorus in the molecule, and that it would be particularly marked in phosphorothionates, in which the lag in poisoning, due to the need for oxidation of the thiono group, would give time for the detoxifying hydrolysis to occur.

Several esters of phosphorothioic acids were prepared and tested for toxicity to *Musca domestica* L., by topical application in acetone, and to *Periplaneta americana* (L.) and mice, by injection; for anticholinesterase activity; and for metabolism by mouse liver and preparations of the insects. Comparisons of the LD50's for the mice and house-flies showed that the phosphorothionates containing a carboxyester group, which comprised O,O-diethyl S-ethoxycarbonylmethyl phosphorodithioate (acethion), O,O-diethyl S-ethoxycarbonylethyl phosphorodithioate (prothion), O,O-diethyl S-1-(2-methoxycarbonyl)propyl phosphorodithioate (methyl methprothion) and malathion, were selectively toxic to the insect, whereas those lacking the carboxyester group, O,O-diethyl S-methoxycarbonyl phosphorodithioate (acethion acid) and O,O-diethyl S-acetonyl phosphorodithioate (ketothion), were not selective; the fact that O,O-diethyl S-carbamidomethyl phosphorodithioate (acethion amide) was selective suggested that amidases are more vigorous in the mouse than in the house-fly. The phosphorodithiolates containing the carboxyester group, O,O-diethyl S-ethoxycarbonylmethyl phosphorothioate (acetoxon) and O,O-diethyl S-ethoxycarbonylethyl phosphorothioate (propoxon), were less selective than the corresponding phosphorothionates, acethion and prothion, and showed higher activity against serum cholinesterase, prepared from human plasma, than the other compounds; very similar values were obtained with other cholinesterases.

When acethion was incubated with a homogenate of mouse liver, assay of the extracted products by chromatography showed that it was almost completely degraded to form acethion acid. As microsomes from the liver have been shown to activate phosphorothionates [*cf. loc. cit.*], mouse microsomes (with reduced diphosphopyridine nucleotide, magnesium chloride and nicotinamide) were incubated with some of the compounds in the presence of serum cholinesterase, and comparison of their anticholinesterase activity with that of the unmetabolised compounds showed that activation occurred in malathion and acethion amide, but degradation in acethion, acethion acid, acetoxon, prothion, methyl methprothion and ketothion. Chromatographic analysis after degradation by microsomes showed that only acethion acid was produced from acethion and that the acid gave no detectable new products. Assay against serum cholinesterase confirmed that minced mouse liver degraded acethion rapidly and almost completely and showed that minced cockroach degraded it considerably, whereas minced house-fly caused slight activation; this was in accordance with the LD50's of 1,280, more than 1,000 and 9·4 μg. per g. for mice, cockroaches and house-flies, respectively.

MISTRIC jr. (W. J.) & GAST (R. T.). **Susceptibility of the boll weevil to toxaphene in North Carolina.**—*J. econ. Ent.* **51** no. 5 pp. 719–721, 1 fig., 5 refs. Menasha, Wis., 1958.

In view of the development of resistance to chlorinated hydrocarbons in *Anthonomus grandis* Boh. on cotton in Louisiana and South Carolina [*cf. R.A.E.*, A **46** 344, 450], laboratory tests were carried out in 1957 to determine whether populations resistant to toxaphene occurred in North Carolina. Adults of the first and second generations were obtained from punctured squares collected in five counties in the second week of July and two in the first week of August, respectively, treated with emulsion sprays of toxaphene at various concentrations and examined for mortality after 48 hours. Squares were selected from at least two fields in each county, including one that had received heavy insecticide applications and one in which few insecticides had been used, and it was found that the weevils from the former were the less susceptible to toxaphene. Resistance of the first generation was lower in Cleveland County, in which the weevil was of little importance and hardly any insecticides had been used against it until 1950, than in the other four, and that of the second was up to 200 times as great in Scotland County, where the weevil had been important for 25 years and nearly all growers used insecticides regularly, as in Wake County, in which cotton is grown in widely-spaced fields and little insecticide is used, and up to 75 times as great in one field as in another within Scotland County.

A field test on the population most resistant to toxaphene in Scotland County showed that dusts of Guthion, malathion, methyl-parathion and calcium arsenate gave better control and a higher yield of cotton than did toxaphene dust, but complete failure of control by the latter did not occur.

DANIELS (N. E.). **Chemical control studies against the greenbug.**—*J. econ. Ent.* **51** no. 5 pp. 722–723, 5 refs. Menasha, Wis., 1958.

Four field tests of organic insecticides for the control of *Toxoptera graminum* (Rond.) on wheat were made in Texas in the spring of 1957. In 5–6 U.S. gal. emulsion spray per acre, about 0·5 lb. parathion, methyl-parathion or Chlorthion gave good control and were superior to similar

quantities of Thiodan or ethion or about 3 lb. of a mixture of toxaphene and DDT (2:1) and at least as effective as mixtures of methyl-parathion with Chlorthion (1:1), Am.Cyanamid 12008 [O,O-diethyl S-isopropylthiomethyl phosphorodithioate] (5:3), demeton and parathion (2:1:2) or demeton (2:1) applied at the same rate and as a mixture of toxaphene, DDT and parathion (4:2:1) applied at 1·75 lb. per acre. The addition of a detergent, a detergent and diesel oil or an adhesive did not enhance the effect of parathion. Dusting by aeroplane with BHC dust (5 per cent. γ isomer) at the rate of 1 lb. γ isomer per acre, had little effect for five days, but then gave satisfactory reductions in aphid population.

McDonald (S.) & Jacobson (L. A.). **The toxicities of some chlorinated hydrocarbons to various larval instars of the army cutworm in the laboratory.**—*J. econ. Ent.* **51** no. 5 pp. 726–729, 2 graphs, 12 refs. Menasha, Wis., 1958.

As chemical control of *Chorizagrotis auxiliaris* (Grote), a sporadic pest of crops in the plains area of Canada and the United States, has not always proved successful, five insecticides were compared as contact and stomach poisons against the sixth-instar larvae under standard conditions of temperature and humidity in the laboratory. Endrin was the most toxic, as both a contact and stomach poison, being 2–3 times as toxic as aldrin or heptachlor and 4–5 times as toxic as chlordane. There were no significant differences between aldrin and heptachlor, and dieldrin equalled them as a contact poison but was superior as a stomach insecticide. Tests with larvae of different ages showed that those in the fourth and fifth instars were more readily killed by contact with the insecticides than those in the sixth instar and that endrin decreased in effect as a stomach poison as the age of the larvae increased, being 35, 11 and 3 times as toxic, respectively, to larvae in the fourth and fifth instars and to newly moulted larvae in the sixth instar as to mature, feeding sixth-instar larvae.

Medler (J. T.). **Seed production and certain growth characteristics of insect-free alfalfa.**—*J. econ. Ent.* **51** no. 5 pp. 729–733, 14 refs. Menasha, Wis., 1958.

Lygus lineolaris (P. de B.), *Adelphocoris lineolatus* (Goeze) and *Empoasca fabae* (Harris) are the most important insect pests of lucerne in Wisconsin, but the losses of forage and seed caused by them are difficult to evaluate. Since differences, particularly in seed production, between plants protected from insects and unprotected ones might give information on the ability of various varieties to withstand attack, 28 clones, mostly of Cossack origin, were studied in a nursery in 1948–49 under conditions of no insect control and control of sucking insects by DDT alone or with other insecticides. More seed was produced in every case where the insects were controlled. The clones showed inherent differences in the quantity of seed produced, but production appeared to be influenced predominantly by the environmental factors obtaining during the different growth periods and years. Measurement of plant stems showed that insect attack consistently shortened the internodes and reduced stem length; the shortening of the internodes occurred below and above the first flowering rachis, indicating a general stunting rather than a reduction in terminal growth only. Injured stems produced the first branch lower on the stem and had more branches per

stem. Increased seed production in protected plants was a result of greater numbers of multiple-podded rachides.

GRISWOLD (C. L.). **Transmission of the oak wilt fungus by certain woodland-inhabiting Drosophilidae.**—*J. econ. Ent.* **51** no. 5 pp. 733–735, 4 refs. Menasha, Wis., 1958.

In further tests in 1955–56 on the transmission of *Ceratocystis fagacearum*, the fungus that causes oak wilt, by Drosophilids that live in woodland [*cf.* *R.A.E.*, A **45** 281, etc.], adults of ten species from infected areas were allowed to feed in the laboratory on fresh, sporulating mats of *C. fagacearum* and transferred to fresh xylem wounds on healthy oaks. *Drosophila putrida* Sturt., *D. funebris* (F.), *D. tripunctata* Lw., *D. buscki* Coq. and *Parascaptomyza disticha* (Duda) transmitted the fungus 1–5 times each in tests with batches of 45–65 insects, and, in spite of the relatively low incidence of transmission and the exacting conditions required for it, they must be considered as potential vectors in the field.

SEMEL (M.). **Tests for the control of** *Tetranychus telarius* **(L.) on lima beans.**—*J. econ. Ent.* **51** no. 5 pp. 735–737, 3 refs. Menasha, Wis., 1958.

Tetranychus telarius (L.) damages lima beans on Long Island, New York, during most growing seasons, and parathion, applied as recommended, sometimes fails to give satisfactory control. Field tests in 1955–57 showed that, though toxic to the mite, parathion was ineffective when the sprays were applied after high populations had developed, whereas two applications, a week apart, of emulsion sprays containing 0·25 lb. demeton or 0·5 lb. phorate (Thimet) or Am.Cyanamid 12008 [O,O-diethyl S-isopropylthiomethyl phosphorodithioate] in about 100 U.S. gal. per acre, all of which act systemically, gave control for the rest of the season. Similar sprays of Kelthane, Hercules AC-528 [2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)], Monsanto 8574 (tetramethyl (dithiodimethylene) diphosphonate), Trithion, Bayer 19639 [O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate], ethion, and Am.Cyanamid 18706 (O,O-dimethyl S-(ethylcarbamoylmethyl) phosphorodithioate) and a wettable-powder spray of Niagara 908 (copper complex of cuprous O,O-dialkyl phosphorodithioate with bis(dialkoxyphosphinothioyl) disulphide) gave promising results.

It is concluded that parathion protects against *T. telarius* only if applied before high populations develop, but that systemic toxicants offer an excellent method of controlling large populations throughout the season.

DEWITT (J. B.). **The function of the Fish and Wildlife Service in insect control programs.**—*J. econ. Ent.* **51** no. 5 pp. 740–741. Menasha, Wis., 1958.

In continuation of studies in the United States on the effects on wild animals and birds of insecticides applied against harmful insects [*cf.* *R.A.E.*, A **35** 177], the effect of accumulated doses or prolonged exposure was investigated. It was found that five applications of DDT at 2 lb. per acre at yearly intervals resulted in a 26 per cent. decrease in numbers of nesting birds. In laboratory experiments, diets containing 100 parts DDT per million before or during the breeding season had little effect on the number

of eggs laid by quail or of chicks hatching, but mortality among the chicks was high during the first six weeks, and less than 10 per cent. reached maturity, even though the chicks themselves received insecticide-free diets. More than 80 per cent. of chicks from untreated parents survived. When DDT was included in the chicks' diet, all the progeny of the insecticide-fed parents but only 30 per cent. of those from the control group died. DDT in the diet of pheasants reduced the numbers of eggs and chicks produced, but had only slight effect on chick viability. Aldrin and endrin were found to be up to 100–200 times as toxic as DDT to young quail and were lethal in concentrations as low as 0·5 p.p.m. Dieldrin, γ BHC (lindane), heptachlor and chlordane were also more toxic than DDT, but methoxy-DDT (methoxychlor) was tolerated for long periods at 500 or 1,000 p.p.m. All these compounds affected reproduction of both quail and pheasants by reducing production, fertility or hatchability of eggs or viability of chicks, and they reduced the growth rate of young birds.

Recommendations for minimising the hazards involved in insect control include keeping rates of application at or below the toxicity equivalent of 2 lb. DDT per acre in oil solution in forested areas to avoid significant loss of birds and of 1 lb. per acre to avoid significant loss of fish, avoiding direct application to streams and other water or to areas in which rapid leaching might occur, unless the rate of application is less than the toxicity equivalent of 0·2 lb. DDT per acre in oil solution or still less in emulsion, avoiding application during the migration, nesting and brooding periods of birds, and treating insect infestations in forests before they reach upper drainage areas or cover large acreages.

WEAVER (C. R.). **An application of multiple regression to comparisons of several meadow spittlebug insecticides.**—*J. econ. Ent.* **51** no. 5 p. 743, 1 ref. Menasha, Wis., 1958.

In 1952–56, 41 experiments were carried out in Ohio on the effectiveness of insecticides for the control of *Philaenus leucophthalmus* (L.), and 198 records were made as to the number of nymphs per stem after treatment, insecticide concentration, volume of water per acre, height of crop, time of application, number of insects per untreated stem and the insecticide used. These were coded and combined in a multiple regression equation, with the number of nymphs per treated stem as the dependent variable and the other factors, including six insecticides, as independent variables. The equation was solved in a manner indicated, and the regression coefficients computed are shown in a table. It was found that all the independent variables except height of crop and volume of water per acre, which are probably significant only as they interact with insecticide, contributed significantly to the variation in the number of nymphs per stem. It is concluded that the equation can be used to predict the latter after treatment under a given set of conditions, and the percentage control, based on the prediction, to evaluate the performance of an insecticide over a wide range of conditions.

MELLANBY (K.). **Water drinking by the larva of the European corn borer.**—*J. econ. Ent.* **51** no. 5 pp. 744–745, 4 refs. Menasha, Wis., 1958.

The larvae of *Pyrausta nubilalis* (Hb.) withstand low temperatures less successfully in spring than in winter, and this change was found to be associated with a rise in water content in the body in the presence of contact moisture [*cf. R.A.E.*, A **45** 93–94]. The possibility that larvae of this

species drink water when they need it was tested in southern England with individuals found overwintering in plant stems.

In December, larvae that were put in contact with water at about 16°C. [60·8°F.] were quite active, but did not drink or absorb water through the cuticle. They were then kept at 5°C. [41°F.] until the following June, when larvae placed in contact with water, again at about 16°C., were seen to drink. Six of eight larvae took up over 10 mg. each in one hour; the other two walked through the water, but did not absorb any. In a further 24 hours, two of the six imbibed a further 9 mg. each, but none of the others took up more water or increased in weight though they became quite wet.

It appears that water is not absorbed through the cuticle in substantial amounts, and that such increase in water content as occurs is due to drinking and is a process under the control of the nervous system.

FYE (R. E.), HOPKINS (A. R.), MCMILLIAN (W. W.) & WALKER (R. L.). **Survival and emergence of boll weevils from several areas under similar hibernating conditions.**—*J. econ. Ent.* **51** no. 5 pp. 745–746, 1 graph. Menasha, Wis., 1958.

For several years, the soil débris in woods near cotton fields of the previous season has been examined to determine the numbers of *Anthonomus grandis* Boh. in hibernation and the proportion that survive until the spring in different parts of the cotton belt of the United States. In November 1956, débris was collected from such areas in North and South Carolina and Virginia and brought to Florence, South Carolina, where all weevils from each area were caged together, with débris, and allowed to continue hibernation. They were examined in March, when 86·8 per cent. of those from Virginia and 55–67 per cent. of the others were living, and returned to hibernation. Records of emergence from hibernation after 1st May showed only 5·3–23·5 per cent. survival, possibly because of the disturbance in March, and emergence was about 90 and 30 per cent. complete by 1st June among insects from southern South Carolina and Virginia respectively, with intermediate results for the other areas. The high survival and late emergence among insects from Virginia indicated that weevils entering hibernation in the northern area are adapted to survive relatively severe winter conditions and to emerge in spring when conditions of weather and plant growth favour survival and reproduction.

Distribution maps of insect pests.—Series A, nos. 103–108. London, Commonw. Inst. Ent., 1959.

These maps are nos. 103–108 of a series already noticed [*R.A.E.*, A **40** 203; **47** 268] and deal, respectively, with *Anarsia lineatella* Zell., *Cydia leucostoma* (Meyr.), *Etiella zinckenella* (Treitschke), *Brevipalpus phoenicis* (Geijskes), *B. californicus* (Banks) and *Anomala orientalis* Waterh.

JOVANIĆ (M.) & GLUMAC (S.). *Hylemyia cilicrura* **Rond. (Anthomyiinae, Muscidae, Diptera)—nova štetočina pšenice** (*Triticum vulgare*) **u Jugoslaviji.** [*H. cilicrura*, a new pest of wheat in Yugoslavia.]—*Arh. poljopr Nauk.* **12** pt. 35 pp. 105–108, 1 fig., 4 refs. Belgrade, 1959. (With a summary in English.)

Larvae of *Hylemyia cilicrura* (Rond.), a pest new to Yugoslavia, were found infesting wheat at two places in the Vojvodina in 1955 and 1957, 40 per cent.

of the crop being destroyed at the first place and 7–8 per cent. at the second. Serious infestation of wheat by this pest has not previously been recorded. The pupae overwintered, but did not enter diapause.

TUKALEVSKIĬ (I. M.) & ROGACHEV (V. L.). **A new pest of tomato and potato in the south of the Ukraine.** [*In Russian.*]—*Zashch. Rast. Vredit. Bolezn.* 1959 no. 5 p. 54, 2 figs. Moscow, 1959.

Aculus (*Vasates*) *lycopersici* (Massee) was found in 1957 attacking tomato and potato in greenhouses and in the field in the Zaporozh'e district of the southern Ukraine. The only other record of this pest from the Soviet Union was from Georgia in 1954. In greenhouses, the mite reproduced throughout the year, one generation lasting 12–15 days. The eggs were laid and the mites fed on the stems and leaves, inhibiting the development of the fruits or tubers and sometimes causing loss of the entire crop. A spray of 0·04–0·05 per cent. parathion killed all the mobile stages, but not the eggs, so that one or two further applications at intervals of 3–5 days were necessary for complete control.

SUBBIAH (M. S.) & MAHADEVAN (V.). **The life history and biology of the Reduviid** *Acanthaspis siva* **a predator of the Indian honey bee** *Apis indica* **F.**—*Indian J. vet. Sci.* **27** pt. 3 pp. 117–122, 2 figs., 3 refs. New Delhi, 1957.

Adults and nymphs of *Acanthaspis siva* Dist., all stages of which are described, prey on the Indian honey bee, *Apis indica* F., in southern India and in some seasons cause heavy mortality. Studies on the bionomics of the Reduviid at Coimbatore in 1953–54 showed that both stages are most abundant during the rains (September–November). There appears to be only one generation a year, and the eggs are laid singly in crevices on the hive stands or on neighbouring accumulations of moist or decaying leaf mould. A female is stated to be capable of laying 252 eggs in 169 days, at a maximum rate of 18 per day. In the laboratory, eggs did not hatch in the absence of moisture, but some withstood dry conditions for over a month. The duration of the egg stage varied within batches and ranged from 17 days in April to 28 in December. Newly hatched nymphs fed on young larvae of *Corcyra cephalonica* (Stnt.), but later readily attacked worker bees and drones. The nymphal stage lasted 107–186 days. Nymphs in the first two instars each required one worker bee per day, and the older nymphs and adults two; one individual therefore consumes about 650 workers during life. Mortality among the eggs and nymphs, especially nymphs in the first instar, is high, and only 7 per cent. of the individuals that hatch become adult. The predator can be kept in check by keeping the base boards of the hives, the hive stands and the surroundings of the apiary in a clean and tidy condition.

PAPERS NOTICED BY TITLE ONLY.

SOKAL (R. R.). **Probit analysis on a digital computer.**—*J. econ. Ent.* **51** no. 5 p. 738, 3 refs. Menasha, Wis., 1958.

VAPPULA (N. A.). **Finnish entomological literature published in 1956, including** [titles of papers on] **economic entomology and control of insect pests.**—*Ann. ent. fenn.* **24** no. 4a 16 pp. Helsinki, 1958. [*Cf. R.A.E.*, A **46** 280.]

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